1977

Accounts of Nepalese mammals and analysis of the host-ectoparasite data by computer techniques

Richard Merle Mitchell
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Accounts of Nepalese mammals and analysis of the host-ectoparasite data by computer techniques

by

Richard Merle Mitchell

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Department: Zoology
Major: Zoology (Parasitology)

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Signature was redacted for privacy.

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For the Graduate College

Iowa State University
Ames, Iowa
1977

TABLE OF CONTENTS

Page

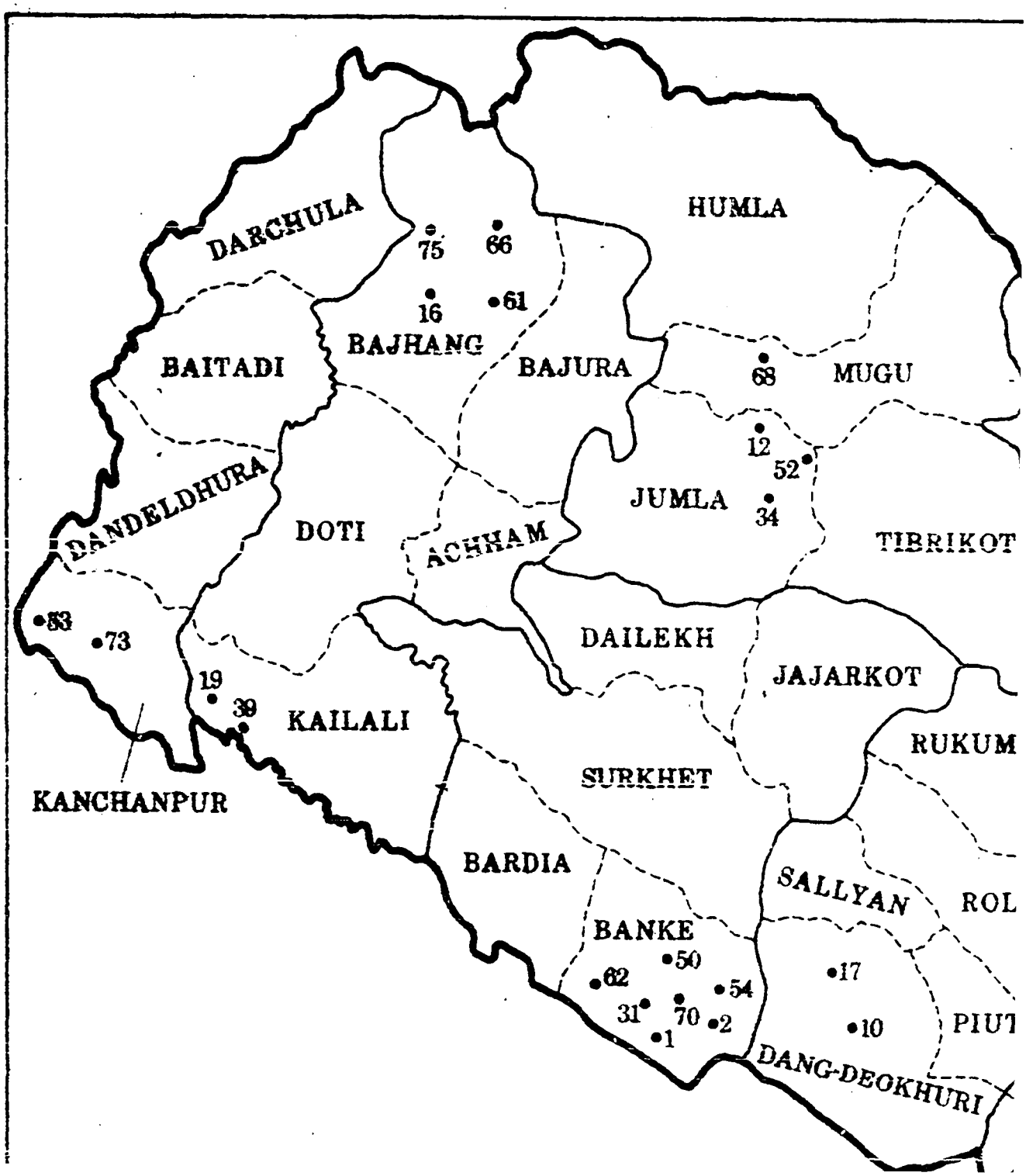
Page

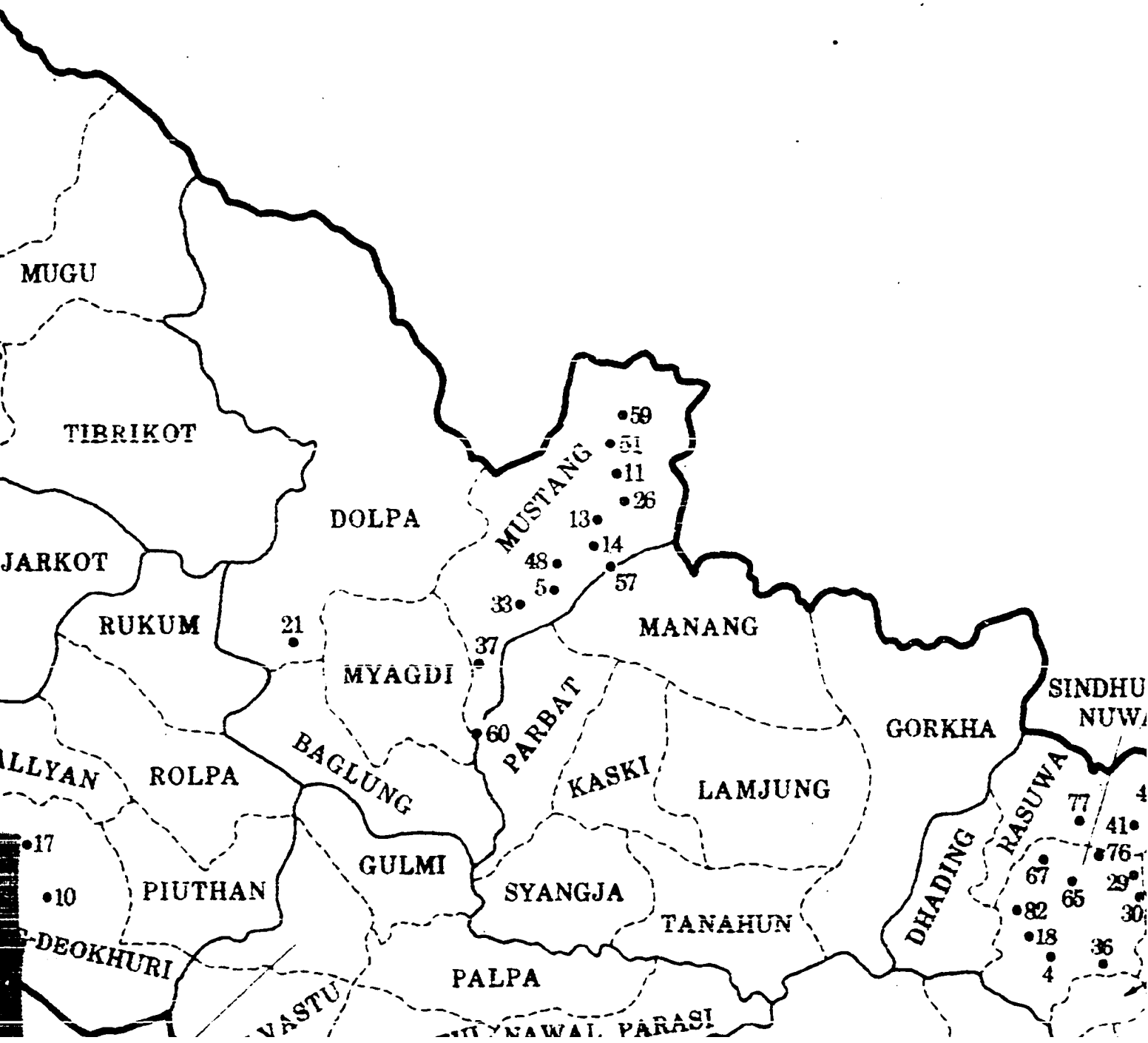
LIST OF TEXT FIGURES

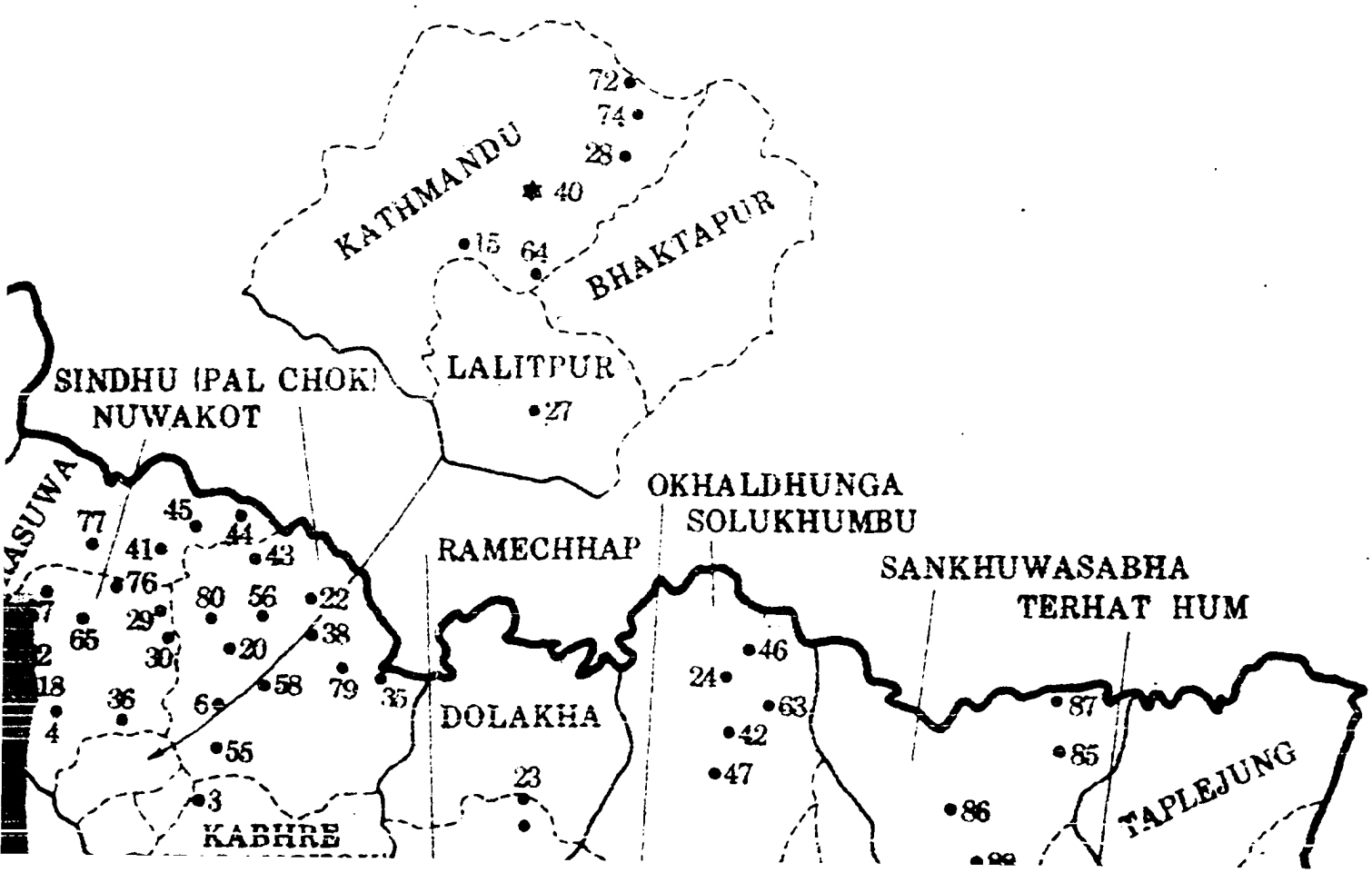
Page

Page

LIST OF TABLES

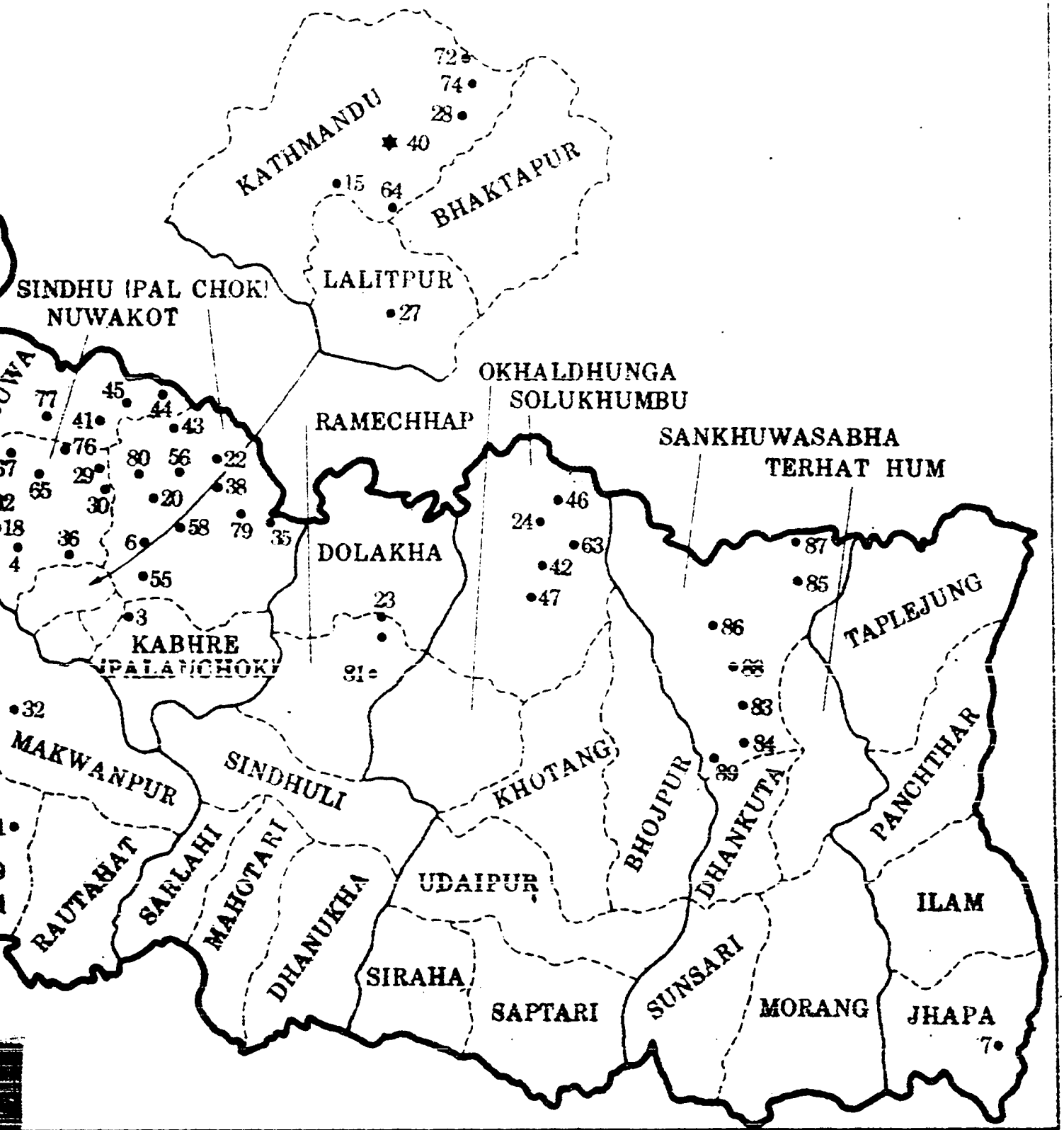

DARCHULA
HUMLA
75
66
16
61
BAJHANG
BAITADI
BAJURA
68
MUGU
12
52
DANDELDHURA
DOTI
ACHHAM
JUMLA
34
TIBRIKOT
53
73
DAILEKH
JAJARKOT
19
39
KAILALI
RUKUM
SURKHET
KANCHANPUR
BARDIA
SALLYAN
ROL
BANKE
50
17
62
54
31
70
2
10
PIUT
1
DANG-DEOKHURI


MUGU
TIBRIKOT
DOLPA
MUSTANG
JARKOT
RUKUM
MYAGDI
MANANG
PARBAT
BAGLUNG
ROLPA
KASKI
LAMJUNG
GORKHA
SINDHU
NUWA
GULMI
PIUTHAN
SYANGJA
TANAHUN
RASUWA
DHADING
DEOKHURI
PALPA
59
51
11
26
13
14
48
5
57
33
21
37
60
17
10
77
41
76
67
65
29
82
18
4
36
30


KATHMANDU
BHAKTAPUR
LALITPUR
SINDHU IPAL CHOK
NUWAKOT
RAMECHHAP
OKHALDHUNGA
SOLUKHUMBU
SANKHUWASABHA
TERHAT HUM
DOLAKHA
KABHRE
TAPLEJUNG
72
74
28
40
15
64
27
77
45
44
41
43
76
80
56
22
29
65
38
30
20
18
58
79
35
36
6
4
55
3
23
24
46
63
42
47
87
85
86


BAITADI
BAJHANG
BAJURA
68
MUGU
12
52
JUMLA
34
DANDELDHURA
DOTI
ACHHAM
TIBRIKOT
53
73
DAILEKH
JAJARKOT
19
39
KAILALI
RUKUM
21
KANCHANPUR
SURKHET
BARDIA
SALLYAN
ROLPA
BANKE
50
62
54
17
31
70
2
1
10
PIUTHAN
DANG-DEOKHURI
ARGHAKHANCHI
KAPILVASTU
• COLLECTION SITES
★ CAPITOL
---- DISTRICTS


DOLPA
MUSTANG
MANANG
MYAGDI
PARBAT
BAGLUNG
KASKI
LAMJUNG
GORKHA
SINDHU (PAL CHOK)
NUWAKOT
KATHMAN
GULMI
SYANGJA
TANAHUN
DHADING
RASUWA
PALPA
RUPANDEHI
NAWAL PARASI
CHITWAN
KABHRE (PALANCHOK)
MAKWANPUR
PARSA
BARA
RAUTAHAT
SARLAHI
MAHOTARI
59
51
11
26
13
14
48
5
57
33
21
37
60
77
45
44
41
43
76
80
56
22
67
29
65
38
82
30
20
18
36
6
58
79
35
4
55
3
78
25
8
9
32
71
49


KATHMANDU
BHAKTAPUR
LALITPUR
SINDHU (PAL CHOK)
NUWAKOT
RAMECHHAP
OKHALDHUNGA
SOLUKHUMBU
SANKHUWASABHA
TERHAT HUM
DOLAKHA
KABHRE
(PALANCHOK)
TAPLEJUNG
MAKWANPUR
SINDHULI
KHOTANG
BHOJPUR
DHANKUTA
PANCHTHAR
RAUTAHAT
SARLAHI
MAHOTARI
DHANUKHA
UDAIPUR
ILAM
SIRAHA
SAPTARI
SUNSARI
MORANG
JHAPA

INTRODUCTION

From September 1966 to August 1970, the Nepal Ectoparasite Program, in conjunction with His Majesty's Government, Ministry of Health, conducted a survey of the ectoparasites and their hosts in the Kingdom of Nepal. Additional material was supplied to the project by the Arun Valley Wildlife Expedition (July 1972 - December 1973). The primary purpose of this undertaking was to collect a geographically and ecologically representative sample of ectoparasites and hosts from high altitudes in the Nepal Himalayas. The host-ectoparasite data were tabulated and numerically analyzed by means of the IBM 360/65 computer to determine host preference, host specificity and infestation rates. The technique of cluster analysis was employed to determine host affinity between geographic realms and life zones.

The objective of this work is to provide an account of the 130 species of terrestrial mammals collected or reported from Nepal, including information on their ecology, distribution, systematics and zoogeographic relationships. In addition, all body measurements of mammals are tabulated to determine mean, range, standard deviation and coefficient of variance.

A literature review and brief introductions to the zoogeography, climate and life zones of Nepal are provided. A gazetteer of 89 major localities visited during the expedition is also included.

ACKNOWLEDGEMENTS

The Nepal Ectoparasite Program was made possible by support funds from Office of Naval Research contracts N62558-5023 and N00014-68-A-0101-0001 to the Principal Investigator, Dr. Robert E. Lewis, Iowa State University, Ames, Iowa. I am grateful to Dr. Lewis for the opportunity to conduct the field phase of the program.

I am especially indebted to Dr. Harry Hoogstraal, United States Naval Medical Research Unit-Three, Cairo, Egypt, for his efforts in supplying our demands for additional equipment, and handling the shipments of hosts and ectoparasites.

Special thanks goes to His Majesty's Government, Ministry of Health, for permitting me to work directly under the expert guidance and supervision of Dr. N. K. Shah, Assistant Director of Epidemiology.

My gratitude is also extended for the cooperation of the American Ambassador, Madam Carol Laise, and her staff, notably Roy Anderson and Robert Jackson; and I am indebted to Mr. George Bell, USAID, for his friendship and support during the project.

Further, I am grateful to Christopher O. Maser, a previous collector in Nepal. Doctors H. B. Emery and J. A. McNeely of the Arun Valley Wildlife Expedition have also kindly permitted my use of their host-ectoparasite data.

The following individuals donated their time to the preparation and identification of the ectoparasites: Dr. K. C. Emerson, United States National Museum, Washington, D. C. (lice); Dr. Harry Hoogstraal, United States Naval Medical Research Unit-Three, Cairo, Egypt (ticks); Dr. Robert E. Lewis, Iowa State University, Ames, Iowa (fleas); Mr. T. C. Maa, B. P. Bishop Museum, Honolulu, Hawaii (parasitic Diptera); Dr. R. W. Strandtmann, B. P. Bishop Museum, Honolulu, Hawaii (mites) and Dr. R. L. Wenzel, Field Museum Natural History, Chicago, Illinois (bat flies).

Dr. Argawal of the Calcutta Museum and his staff made many of the facilities of that institution available to me and generously donated his time in helping to identify representative species of mammals. Doctors Robert L. Fleming, Sr. and Jr., of Kathmandu identified the birds and furnished many helpful suggestions in the collecting of specimens.

The program could not have been accomplished without the efforts of the late Captain Jai Singh, His Majesty's pilot, in providing air and helicopter transportation and liaison with our party when we were collecting in remote areas.

Mani K. Lama, my assistant, in his devotion and dedication to the project, proved to be an excellent field collector and companion. His expedition to the Mustang District turned up several new species of fleas and the first new genus of

ticks to be described in the twentieth century.

I cannot begin to describe the gratitude that I have for my wife, Marleane, who courageously accompanied me on every field trip and lent the moral support that I needed to undertake such a project. She spent many long hours photographing collecting sites, recording field data and supervising the kitchen.

LITERATURE REVIEW

Mammals

For centuries, the Kingdom of Nepal was closed to westerners, until the British government sent an envoy to the Kathmandu Valley in 1815. A few mountain climbing expeditions entered Nepal in the early 1920's from the northern approach of Mt. Everest. In 1952 for the first time, foreigners were officially permitted to enter Nepal. Even today a special permit is required to visit areas outside the Kathmandu Valley. Due to these restrictions, few scientific expeditions were undertaken until the late 1960's.

The researches of B. H. Hodgson (1822-1843) laid the foundation of mammalogy in Nepal. He published over 100 papers on the mammals of the area. Many of Hodgson's locality records are in doubt, since he was confined to the Kathmandu Valley and had to depend on traders and local hunters for many of his specimens. He collected 373 mammal specimens belonging to 70 genera and 114 species, 40 of which were subsequently described as new. A number of these were later synonymized and have since been deleted from the literature. Gray (1846, 1863b) published a checklist based on Hodgson's Nepalese mammal collection housed in the British Museum.

From the 1850's to the 1900's, mammal surveys were carried out by the British in India and the Himalayas. Compre-

hensive works on the mammals of the region were published by Jerdon (1867) and Blanford (1888-1891). Scully (1887) published an account on bats collected from the Kathmandu Valley.

In the 1920's, the first high-altitude series of mammals was collected from Nepal. Thomas and Hinton (1922) reported on a series of mammals from the Mt. Everest region which consisted of 52 specimens belonging to 10 species, of which two species and one subspecies were described as new. The majority were pikas (Ochotona) and voles (Pitymys). Ochotona wollastoni (=macrotis), O. nubrica (=pusilla) and O. roylei baltina represented the new taxa.

Hinton (1922b) listed a collection of rats from the Kathmandu Valley and nearby surroundings which included three species and four subspecies. Hinton and Fry (1923) published a checklist of the Nepalese mammals which contained 81 genera and 119 species. Thomas (1924) described a new field mouse, Apodemus gurka (=Apodemus flavicollis gurkha), from the western sector of the country. Fry (1925) listed a large collection of mammals from districts west of the Kathmandu Valley, and Lindsay (1929b) reported the discovery of a new flying squirrel, Sciuropterus gorkhali (=Petaurista elegans gorkhali).

Pocock (1939, 1941) published two volumes on the primates and carnivores of British India; for Nepal he listed four

species and subspecies of primates and 41 species and subspecies of carnivores. Ellerman (1947 a & b) published a key to the rodents of India, Ceylon and Burma, which included 21 genera and 31 species from Nepal.

Sanborn (1950) collected the bat Plecotus homochrous from Nepal. Biswas and Khajuria (1955) reported on a small collection of mammals from the Solukhumbu region of eastern Nepal and described four new mammals: Ochotona angdawai, Rattus rattus khumbuensis, Mus musculus pygmaeus, and Alticola bhatnagari. This collection included 52 specimens belonging to 21 species and subspecies (Biswas and Khajuria 1957).

Ellerman and Morrison-Scott (1966), in their account of the mammals of the Palaearctic Region and Indian subcontinent, included 71 genera and 106 species of mammals from Nepal. Frick (1968) reported 169 species and subspecies in his checklist of Nepalese mammals. Caughley (1969) listed 16 genera and 17 species from the Trisuli watershed area, and Chesemore (1970) published notes on mammals collected or sighted in southern Nepal.

In 1965, the Nepal Health Survey collected 460 specimens belonging to 18 genera and 28 species, from 15 different localities in the country. Particulars on these collections were published by Worth and Shah (1969). Weigel (1969) reported on the investigations of the Nepal Himalaya Expedition, 1968, which studied the insectivores and rodents of

eastern Nepal. Three hundred twenty-five mammals representing 10 genera and 14 species were obtained. One new species and subspecies were described and four new locality records were reported. Abe (1971) collected 231 small mammals consisting of 31 species from central Nepal. Martens and Niethammer (1972) reported Apodemus sylvaticus wardi for the first time from Nepal. Their collection included 23 specimens of A. s. wardi and 44 of A. flavicollis gurkha, taken from the Dolpa and Mustang Districts.

Birds

The Nepalese avifauna consists of over 800 species and subspecies. Only one endemic species, the spiny babbler (Turdoides nipalensis), is known; all others are shared with the Indian subcontinent (Pakistan, India, Sri Lanka, Bangladesh and Assam). Water birds and waders are poorly represented in the country since the main migratory flyways are over Kashmir and Burma. A few waterfowl funnel into the Nepal Terai via low mountain passes.

The pioneer avifaunal studies of the Himalayas were carried out mainly in India, but early workers also collected birds in Nepal. B. H. Hodgson resided for 25 years in Kathmandu (1822-1847) and his bird collections totaled well over 20,000 skins (Ali and Ripley 1969) consisting of 658 species representing several new families, over 20 new

genera and 179 new species (Gray 1846, 1863b). Scully (1879) recorded over 300 species from the Kathmandu Valley and surrounding areas.

In the twentieth century, the first bird collections from the area were associated with mountaineering ventures. Kinnear and Wollaston (1922), Hingston (1928) and Kinnear (1939) all reported on birds collected from the Mt. Everest region.

Following World War II there was an influx of ornithologists to the Indian subcontinent. In 1947, Biswas and Koelz collected birds from the central Terai along the main route to Kathmandu and within a 15 mile radius of the valley. Biswas reported on this collection, which totaled about 3500 specimens, representing about 350 species and subspecies, in an 11-part series published in the Journal of the Bombay Natural History Society (August 1960 to December 1963).

Smythies (1948, 1950) recorded birds from central Nepal and Kathmandu Valley. Ripley (1950a) reported on close to 1600 birds representing 331 species and subspecies from the eastern and western Terai and Kathmandu Valley. Ripley (1950b) also described eight new subspecies from the area. Proud (1949, 1952 a & b, 1955, 1958, 1961 a & b), over a 12 year period, collected or sighted over 350 species of birds in the Kathmandu Valley and surrounding region.

Lowndes (1955) listed birds collected from Manangbhot,

northwestern Nepal, during a mountaineering expedition; and Polunin (1955) reported on the botanical, geological and ornithological findings from Langtang Khola, central Nepal.

The foremost authorities on Nepalese birds are Drs. Robert L. Fleming, Sr. and Jr., who have resided in Kathmandu for 20 years. The Flemings have collected one of the most extensive series of birds from Nepal and the Himalayas. They have collected over 56 species and subspecies for the first time from Nepal, of which two subspecies are new to science. Rand and Fleming, Sr. (1956, 1957), Fleming, Sr. (1953, 1959, 1963, 1968) and Fleming and Traylor (1961, 1964, 1968) have reported on these extensive collections. Fleming, Jr. (1968, 1969) listed new locality records for two birds, Bombycilla garrulus and Columba rupestris. The Flemings (personal communication) reported collecting over 750 species and subspecies of birds from Nepal. Their book, which is presently in preparation, will include over 830 species and subspecies.

In the 1960's, a few collections were made from various localities throughout the country. Paynter (1961) studied Corvidae from the Pokhara Valley; and Diesselhorst (1968) collected over 1,700 specimens, representing 248 species and subspecies, from the Rapti Dun, the Kathmandu Valley, and the Solukhumbu District. Ali and Ripley (1968-72) have a nine-volume series covering 2,100 species and subspecies, of which

over 700 species and subspecies are listed for Nepal.

Ectoparasites

The bloodsucking, invertebrate parasites of Nepal that are potential or known reservoirs or vectors of infectious disease agents were unknown before 1960. Two major surveys, the Nepal Health Survey (1965-1966) and the Nepal Ectoparasite Program (1966-1970), accumulated a vast amount of field data and collections of ectoparasites; and the Arun Valley Wildlife Expedition, begun in 1972, has continued the work in eastern Nepal.

Following is a brief report on the various groups of ectoparasitic arthropods.

Fleas

Before the Nepal Health Survey (1965-1966) and the Nepal Ectoparasite Program (1966-1970), the flea fauna of Nepal was essentially unknown. In 1950, Traub described a new subspecies of fleas, Macrostylophora hastata nepali, from Dhankuta, eastern Nepal, and in 1968 he described a new genus and species, Evansipsylla thysanota, from Langtang Valley. He (1969) also listed 18 genera and 23 species of fleas collected by the Nepal Health Survey. Several new species await his description.

Most of the flea collections have been studied by R. E. Lewis, and three new species, attributed to new genera, have

been described. They are: Mitchella exsula Lewis, 1970, Rowleyella arborea Lewis, 1971 and Smitipsylla maseri Lewis, 1971. Additional new species described by Lewis are listed below.

Ancistropsylla nepalensis Lewis, 1968
Stenischia pagiana Lewis, 1969
Paraneopsylla ioffi nepali Lewis, 1971
Neopsylla pagea Lewis, 1971
Neopsylla mantissa Lewis, 1971
Neopsylla marleaneae Lewis, 1971
Callopsylla fusca Lewis, 1971
Citellophilus mygala Lewis, 1971
Citellophilus atallahi Lewis, 1971
Chaetopsylla gracilis Lewis, 1971
Ctenophyllus triangularis Lewis, 1972
Palaeopsylla tauberi Lewis, 1973
Palaeopsylla helenae Lewis, 1973
Paradoxopsyllus acanthus Lewis, 1974
Paradoxopsyllus digitatus Lewis, 1974
Paradoxopsyllus hollandi Lewis, 1974
Paradoxopsyllus magnificus Lewis, 1974
Paradoxopsyllus mustangensis Lewis, 1974
Paradoxopsyllus oribatus Lewis, 1974
Paradoxopsyllus paraphaeopis Lewis, 1974
Paradoxopsyllus spinosus Lewis, 1974

Other undescribed taxa remain to be studied. Further reference to the siphonapteran fauna of Nepal may be found in papers by Lewis (1968, 1969, 1970, 1971 a-e, 1972b, 1973a, 1974a).

Ticks

The Himalayas harbor a rich tick fauna, especially the primitive genus Haemaphysalis, and Nepal is the ecotone for an extensive array of poorly-known, endemic Himalayan species. Earlier tick studies for the area centered on the Darjeeling District of India. There are few early reports

on the Nepalese tick fauna, most of them by H. Hoogstraal. The following papers are accounts of ticks collected from Nepal:

Hoogstraal (1962) described a new tick, Haemaphysalis nepalensis, and the male H. aponommoides from the Ramechap District of eastern Nepal. Dhanda (1964) reported on new hosts for H. nepalensis and described its nymphal stage. In 1965 the Nepal Health Survey collected a small series of ticks, consisting of four genera and four species, from various localities in the country (Worth and Shah 1969).

In 1966, Hoogstraal described Haemaphysalis himalaya, a parasite of the Himalayan tahr (Hemitragus jemlahicus), from northwestern India. Subsequently, Hoogstraal and El Kammah (1970) described the immature stages, hosts and distribution in Nepal. Nemenz (1968) described a new tick, Ixodes moschiferi, collected from the musk deer (Moschus moschiferus).

In 1970, several new species were described and new records from Nepal were published. Hoogstraal (1970b) listed six genera and 16 species of ticks infesting humans from the foothills and mountains of Nepal. Hoogstraal and Dhanda (1970) reported on Haemaphysalis darjeeling parasitizing artiodactylan mammals in the Himalayan forests of India, Burma and Thailand. Hoogstraal et al. (1970) described the adults, nymphs and larvae of Anomalohimalaya lama, the first

new tick genus to be discovered in the twentieth century. This parasite was collected from three localities in the alpine desert biotope of the Mustang District.

Kohls et al. (1970) described a new tick, Ixodes mitchelli, that parasitizes pheasants and partridge in the high Himalayas. Dhanda et al. (1970) reported a new tick, H. ramachandrai, from northern India and Nepal. Nepalese collections were taken from large carnivores (Panthera pardus and P. tigris) and cervids (Cervus unicolor). Hoogstraal (1970a) redescribed the male and female of H. (H.) birmaniae and a new species, H. (H.) goral. Numerous collections of H. (H.) birmaniae were collected from the central midlands and Gokarna, Kathmandu District.

Hoogstraal (1971a) published data on the identity, hosts and distribution of Haemaphysalis (Rhipistoma) canestrinii. H. canestrinii was collected from the Nawal Parasi District and the Kathmandu Valley. Nymphs were obtained from the palm squirrel (Funambulus pennanti) and Mus sp., while adults were taken from the fishing cat (Felis viverrina) and the leopard (Panthera pardus).

Haemaphysalis aponommoides Warburton, 1921, had previously been reported from a collection of eight adults. Hoogstraal (1962) described the adult male and Hoogstraal and Mitchell (1971) reported on the immature stages, hosts, distribution and ecology. Immature stages were collected from

pheasants, insectivores and small rodents. Adult ticks were taken from artiodactylan mammals.

Hoogstraal et al. (1971) described a new subgenus Aborphysalis of Asian Haemaphysalis ticks. In the same paper, they redescribed the tick H. aborensis Warburton, 1913, and reported on its hosts and distribution.

Hoogstraal (1971b) described the immature stages, adult structural variation, hosts and ecology of Haemaphysalis (Allophysalis) warburtoni Nuttall, 1912. He also redefined the subgenus Allophysalis and H. (A.) warburtoni, the type species of the subgenus Allophysalis. Nepal collections of 30 adults and 471 immature specimens provided data for redefining the subgenus.

Ixodes (I.) nuttallianus Schulze, 1930, prior to the Nepal Ectoparasite Program was known only from five female specimens taken from deer in China. Data on 110 adults from 25 collections taken in northcentral Nepal and nearby Tibet were presented in a paper by Clifford et al. (1971b), which included a redescription of the female and description of the male. In addition, host preference and ecological data were discussed. Goat antelopes (Capricornis sumatraensis, Naemorhedus goral) and domestic livestock were most frequently infested.

Clifford et al. (1971a) also described two new species, Ixodes hyatti and I. shahi, taken from pikas (Ochotona) in

the high Himalayas of Nepal and West Pakistan.

Hoogstraal et al. (1973) proposed a new subgenus, Partipalpiger, for I. ovatus. Hosts, ecology and distribution of this species were also reviewed. Hoogstraal and Kaiser (1973) described a new argasid tick, Argas (Argas) himalayensis, from larvae infesting the snow partridge (Lerwa lerwa). Finally, Clifford et al. (1975) reported on the Ixodes ticks of Nepal.

Mites

Nepal harbors a rich, but little known, mite fauna. Both the Nepal Health Survey and the Nepal Ectoparasite Program collected large numbers of mites. Due to the large number of specimens, the process of clearing, mounting and identification has lagged. To attest to the plentitude of the mites, over 50% of all hosts collected by both surveys were infested with mites, and over half the mites collected by the Nepal Health Survey were new species.

During the Nepal Health Survey, 57 species of mites were taken from 305 animals; 35 of these proved to be new species. Nadchatram (1969) listed the species of chiggers as well as the hosts and collection sites.

Allred (1969), in his paper on haemogamasid mites of eastern Asia and the western Pacific, listed two genera and seven species from Nepal. He also described a new species, Haemogamasus suncus, from insectivores from the central midlands.

Fourteen species of chiggers, six new, belonging to the genus and subgenus Leptotrombidium, were collected by the Nepal Health Survey (Nadchatram 1970). A new species, Myonyssus tuberosus, from small rodents, was described by Strandtmann and Garrett (1970).

Lice (Anoplura and Mallophaga)

Literature on the Mallophaga and Anoplura of the Himalayas is nearly nonexistent. The Nepal Health Survey collected a moderate number of lice, but no papers resulted from these data. The Nepal Ectoparasite Program collected over four thousand specimens and to date, one paper has been published from this material. Emerson (1971) in his paper on the Mallophaga of Nepal listed six genera and 10 species taken from mammals.

Botanical Surveys

Botanically, Nepal is of particular interest because here the floras of the eastern and western Himalayas merge. The history of plant collecting in the country is divided into two periods, 1850 to 1952 and 1952 to the present. During the first period, Nepal remained closed to foreigners, and scientific investigations were limited to the Kathmandu Valley and the Nepal-Darjeeling border.

Hooker (1854) published the first definitive work on

the flora of the eastern Himalayas. He collected botanical specimens along the Sikkim-Nepal border. Burkhill (1910) published an account of the vegetation of central Nepal and Landon (1928) cited 1672 species of Nepalese plants in his two volume work. Hay (1934) summarized the botanical investigations of these early botanists and also reported on plants found in central Nepal.

The second period of phytogeographical investigations began with the opening of the country to scientists in about 1950. Polunin (1950 a & b) surveyed the flora of Langtang Valley and Rasuwa District. Banerji (1952 a & b, 1953a, b & c, 1958) reported on six botanical collecting trips made to eastern Nepal. He summarized the collection activities in his 1965 paper.

In 1952, the British Museum, in conjunction with the Royal Horticultural Society, sent a team of botanists to collect plants from northwestern Nepal. Williams (1953) reported on the collection of over 5,000 herbarium specimens by the expedition.

In 1953 and 1954, the Fauna and Flora Research Society of Japan sent two scientific and mountaineering expeditions to central Nepal. Kihara (1955, 1956) edited the results of these expeditions and published two volumes on the botanical findings. From 1960 to 1963, the University of Tokyo collected over 60,000 plant specimens from the

eastern Himalayas. Hara (1963, 1966, 1968) reported on the accounts of these expeditions, and in 1971 he also published on the plants collected by two later expeditions (1967 and 1969) in Nepal, Sikkim and Bhutan.

Pande (1967) and Suwal (1969) reported on the results of plant surveys undertaken by His Majesty's Government, Ministry of Forests, Department of Medicinal Plants, in the Kathmandu Valley. Stainton (1972), after collecting plants between 1953 and 1968, published a book on the forest types, plant distribution and geographical divisions of Nepal.

BIOGEOGRAPHICAL CONSIDERATIONS

Physiography

Nepal is shaped like an elongated rectangle 800 km long and 160 to 240 km wide. It has a total area of about 141,000 sq km which approximates the size of the state of Arkansas. It is bounded on the north by Tibet and on the east, south and west by India. The northeast corner (Taplejung and Panchthar Districts) borders Sikkim.

The Himalayas, the highest mountains in the world, separate Nepal from the Tibetan Plateau. These mountains extend the entire length of the northern border and form an almost impenetrable barrier, breached only by a few low passes. Environments ranging from tropical to arctic occur within the political boundaries of the country.

Nepal is divided into 75 political districts (Fig. 1) and seven broad zoogeographical zones, each diagrammatically illustrated in Fig. 2. These regions, in order of diminishing altitude and from west to east are: (1) the inner Himalayas, (2) Tibetan Plateau (Highlands), (3) Midlands (west and east), (4) Mahabharat Lekh, (5) Siwaliks, (6) Duns and (7) Terai (west and east). Although the Terai and midlands are divided into west and east, they are generally treated as a single zoogeographical unit.

Zoogeography

The zoogeography of the Himalayas is of great interest since Nepal lies in the zone of intermingling between two major zoogeographic realms, the Palaearctic and the Oriental. The Himalayas serve as a faunal barrier, but in low mountain passes, Palaearctic and Oriental species are exchanged. Nepal also lies in the transition zone between three major subregions, the Manchurian of the Palaearctic and the Indian and the Indo-Chinese of the Oriental. The Oriental Region was first proposed as one of the six zoogeographical regions of the world by Sclater (1858). It includes tropical Asia and closely associated islands, such as Sri Lanka, Sumatra, Java, Borneo, Taiwan and the Philippines (Darlington 1957). It encompasses all of the Indian subcontinent, excluding West Pakistan and the higher reaches of the Himalayan Mountains, although the Oriental fauna and flora do extend up to 3500 m in Nepal. The Palaearctic Region is essentially Eurasia above the tropics (Darlington 1957).

The penetration to altitudes as high as 3500 m in the Himalayas by subtropical and tropical faunal forms is related to local microclimates and the presence at relatively high altitudes of tropical evergreen forests. The persistence of these tropical forests have provided stepping stones for incursions of Indo-Chinese faunal types into the drier regions of southern India.

The Satpura Hypothesis (Ali 1949; Hora 1950, 1953) suggested that the main route of immigration of Malayan faunal elements was along the Assam Hills and the Himalayas, and into peninsular India via the Satpura trend of mountains. It postulated that from a center of origin in the Szechuan-Yunnan area, faunal and floral elements spread over the newly upraised Himalayan trend, over the mountain ranges of Assam, westward over the eastern Himalayas, and into the Garo Hills gap. From there they spread over the Saptura trend of mountains, across the Indian peninsula to the Western Ghats and southward along that trend to Cape Comorin and Sri Lanka (Ali 1949). This would explain the strong Indo-Chinese faunal and floral affinities (over 70%) of Nepal. The high Himalayas have also served as a Palaearctic refugium, and many of the animal species found there today represent Palaearctic faunal elements.

Several authors (Biswas 1966; Chesemore 1970; Hagen 1961; Karan 1960) have divided Nepal into seven broad bio-geographical life zones. Stainton (1972) listed eight geographic and vegetational divisions. Troll (1967) and Haffner (1967) discussed the climatic zones and Hara (1966) described the phytogeography of the eastern Himalayas with reference to eastern Nepal. Bhatt (1964) and Banerji (1965) listed five major vegetational and climatic zones, while Schweinfurth (1957) handled the horizontal and vertical vege-

tational zones for the country.

Climate

Reliable data on the climate are scarce. Meteorological observations were kept by Kihara (1956) from the 1952 and 1953 Japanese expeditions. Since 1962, the Swiss have maintained several meteorological stations in eastern and western Nepal. Hagen (1961) recorded precipitation and temperatures during his seven year stay. Kraus (1966) charted the climatic patterns for eastern Nepal in his meteorological researches of the Himalayas.

Nepal has a monsoon climate with heavy rainfall from mid-June through September. Nearly 80% of the total precipitation falls within this period. The characteristic mark of the monsoon climate is the preponderant summer east wind. Monsoon rains approach from the Bay of Bengal, thus reaching the eastern portion of the country first. Precipitation decreases steadily from east to west. The altitude of the great Himalaya range has a profound effect on the climate, protecting the southern portion of the country from cold winter winds generated in the Tibetan Plateau.

Climatic Divisions

Located between the tropical Gangetic Plain and the arid, alpine Tibetan Plateau, Nepal has an intermediate

climatic pattern with considerable variation due to the great altitudinal difference within such a small area. At least three major climatic zones are recognized for the country: (1) the hot and humid tropical and subtropical region of the Terai, Siwaliks and duns, (2) the cooler (microthermal) region of the Mahabharat Lekh and midlands and (3) the subalpine and alpine region of the greater Himalayas and Tibetan Plateau (Karan 1960; Kawakita 1956).

Precipitation

Rainfall

Precipitation figures for Nepal are cited from the following: Hagen 1961, Hara 1966, Karan 1960, Kihara 1956, Kraus 1966 and Stainton 1972. Rainfall figures from different regions of the country are listed in Table 1.

A moderate climate is found only in the mountain valleys between 1500 to 2500 m. The rest of the country suffers either from extreme heat, as in the Terai and duns, or extreme cold, as in the mountainous areas to the north. The Terai is an area of tropical monsoon climate. The summer monsoons and the practically rainless winters extend into mountain valleys to an elevation of 4500 m. Some areas of the east receive up to 3000 mm of rainfall annually compared to 800 mm in the far west.

The Himalayas are a one-sided meteorological limit.

Table 1. Rainfall figures for Nepal.

Life zone	Location and altitude	Average amount of precipitation (in mm)
East Terai	Biratnagar 150 m (1949-1960)	1687
East Siwaliks	Darjeeling[a] 2100 m	3100
East Siwaliks	Dharan 300 m	2366
East midlands	Jiri 1895 m (1962-1964)	2387
Central midlands	Kathmandu 1340 m (1962) (Avg. 27 year period)	1419
West midlands	Pokhara 910 m (1957-1965)	3477
West midlands	Jumla 2300 m (1957-1964)	747
Tibetan Plateau	Jomosom 2650 m (1959-1963)	295
Greater Himalayas West	Dhorpatan 3000 m (1963)	1500
East	Namche Bazaar 3400 m	940
West Terai	Kanchanpur 150 m	762

[a]Darjeeling, West Bengal, India

They receive moisture only from the south side. In the midlands and in some of the mountain valleys, there is another local differentiation--dry valleys. These dry valleys are insulated by the surrounding mountains. On the northern side of the Himalayas (Tibetan Plateau) little precipitation falls during the summer months.

The moist monsoon air approaching from the Bay of Bengal is forced to rise when it meets the mountains. In general, then, the southern slopes of the mountain ranges receive very heavy rainfall. Pokhara (west midlands), which lies close to the southern flank of the Annapurna Range, receives the heaviest rainfall of any place in Nepal at which meteorological records are kept.

Snow

Snowfall is heaviest in western parts of the country and the snowline extends lower than in the east. By mid-April the snow melts from much of the eastern alpine region, while most of the snow disappears from the western alpine region by early June.

Temperature

Except for the Kathmandu Valley, temperature records have been little kept in Nepal. A few records, for short periods of time, were recorded by me. The yearly mean temperature at Kathmandu (1340 m, 27 year period) is 18.1^{o}C

with a mean maximum of 23.9°C and a mean minimum of 9.8°C (Kawakita, 1956).

From 24 January, 1969, to 10 February, 1969, the daily mean maximum and minimum temperatures for Dhorpatan, Dolpa District (3000m), were: mean maximum 12°C, mean minimum -18°C. Kraus (1966) listed readings for the months of January and February 1965 for Dhorpatan as mean prox. 13°C, 11°C, mean min. -21°C, -17°C.

Temperature readings from Nepalganj (western Terai) were recorded for two separate periods, 30 March, 1968 to 14 April, 1968 and 19 December 1969 to 7 January, 1970. For the first period, the mean maximum temperature recorded was 41.1°C and for the second, 19.4°C. Temperatures as high as 47.2°C were recorded from Nepalganj.

Thus, the temperature patterns are: Pre-monsoon heat from mid-March to early June raises the temperature to 39°C - 47°C in the Terai and foothills. In the midlands (2500 to 3500 m), because of the cooling monsoons, temperatures fluctuate between 6°C and 11°C. Winter temperatures reach a low of -30°C in the inner Himalayas.

Life Zones

Following is a discussion of climate and phytogeography of each of the major zoogeographical zones. The zones are treated in order of ascending altitude.

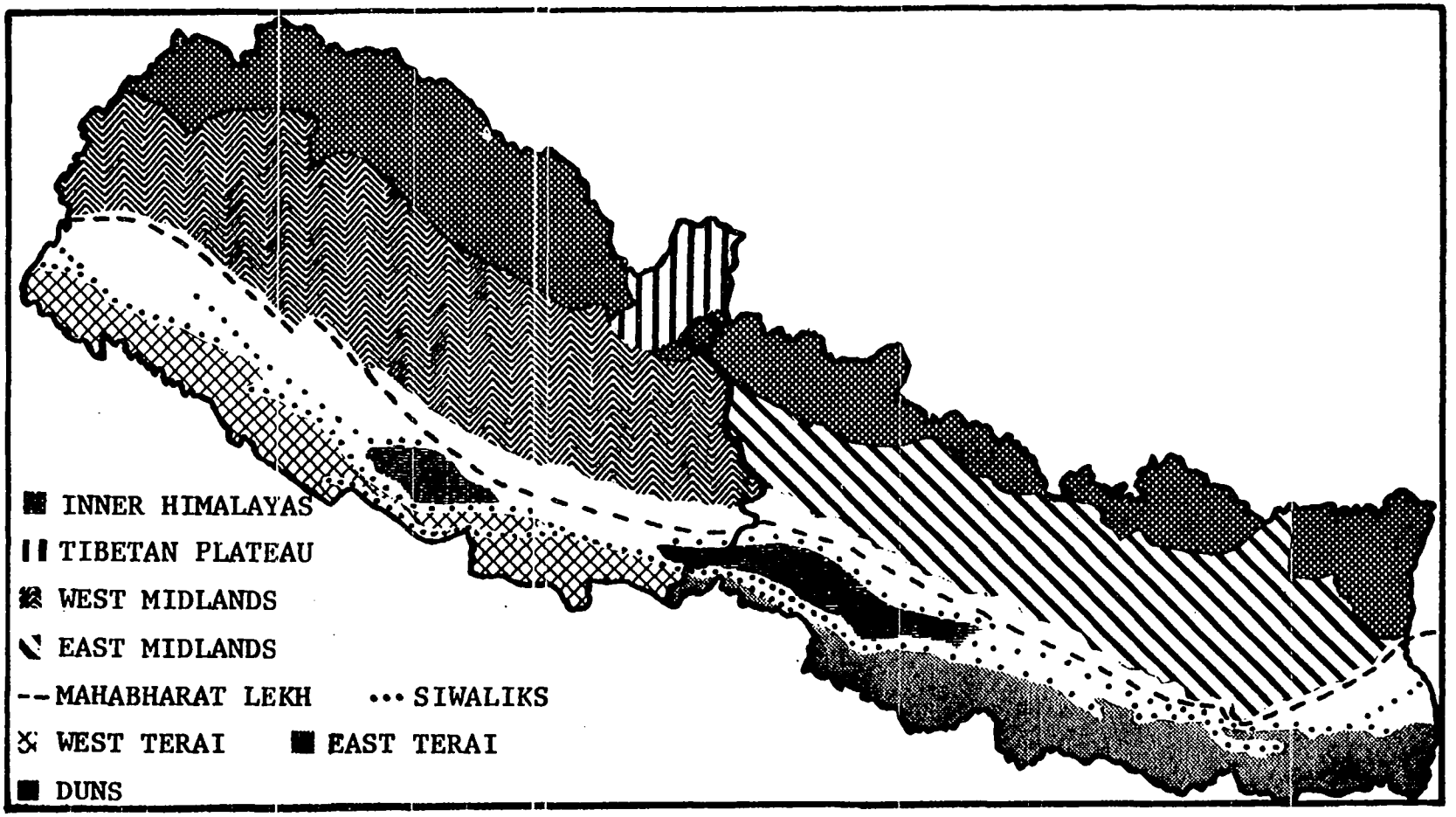


Fig. 2. The life zones of Nepal

The Terai

The Terai comprises the northern extension of the Gangetic plain and varies in width from 25 to 36 km. It extends across the entire northern border of India and ranges in elevation from 100 to 300 m. This region is a land of rivers and is arbitrarily divided into west and east along the Narayani River (Fig. 2). From mid-June through September monsoon rains fall, accounting for approximately 80% of the total precipitation. Precipitation decreases steadily from east (1700 to 2000 mm) to west (700 to 900 mm) (Karan 1960).

The tropical deciduous and semideciduous forests of the Terai are divided into three major types (Stainton 1972): (1) Homogenous sal (Shorea robusta) forests (Fig. 3) grow in fairly open stands, with little undergrowth except grasses (Saccharum, Andropogon and Setaria). These stands cover the higher regions of the Terai and the hills along the southern edge of the Siwaliks. (2) The riparian forests, found along the rivers and streams, are composed primarily of Acacia catechu and Dalbergia sissoo. These forest areas are subject to annual flooding during the monsoon period. (3) A mixed forest zone occupies the area between the riparian and sal forests. Banyan (Ficus religiosa), Jarul (Lagerstroemis), silk-cotton (Salmalia) and Semal (Bombax sp.) are prominent species of the mixed forest zone.

Large portions of the Terai have been cleared for

Fig. 3. The homogenous sal forests (Shorea robusta) of the western Terai; Sisaiya, Kanchanpur District (200 m).

Fig. 4. The elephant grass complex of the eastern Terai; Madhuban, Bara District (65 m). Dominant vegetation types: Cymbopogon sp. and Bothriochloa sp.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agriculture and are now indistinguishable from the Gangetic plain to the south. Both are treeless except for scattered mango groves and for elephant grass (Cymbopogon sp. and Bothriochloa sp.) which predominates in these disturbed areas (Fig. 4).

The Siwaliks

The Siwaliks (Fig. 5) comprise the southernmost foothills of the Himalayan system. These sandstone hills rise out of the Gangetic plain; and the elevation varies from 300 to 1200 m, the highest peaks reaching approximately 2000 m. It is not an independent range, for in some areas the Mahabharat chain, which lies behind and to the north, merges directly into the Siwaliks. In other areas the two ranges are separated by the dun valleys. This range of low hills extends the entire length of Nepal.

A large number of streams originate in the Siwalik Range. The dominant floral components are the subtropical moist hill pines (Pinus roxburghii, P. excelsa). Tropical deciduous vegetation occurs in the east and subtropical deciduous forests develop farther west. The eastern forests consist of sal (Shorea robusta) on the lower slopes, with Schima-Castanopsis forests growing from 700 to 2000 m. Subtropical evergreen forests of Eugenia tetraginia and Ostodes paniculata occur between 1000 and 1800 m. In west Nepal, the forests consist of sal at lower elevations (300 to 500 m) and

Fig. 5. The Siwalik foothills near Megauli, Chitwan District (350 m). Forests consist of Shorea robusta on lower slopes and Schima-Castanopsis on upper slopes.

Fig. 6. The heavily farmed lower slopes of the Mahabharat Lekh near Bhimphedi, Makwanpur District (1500 m).


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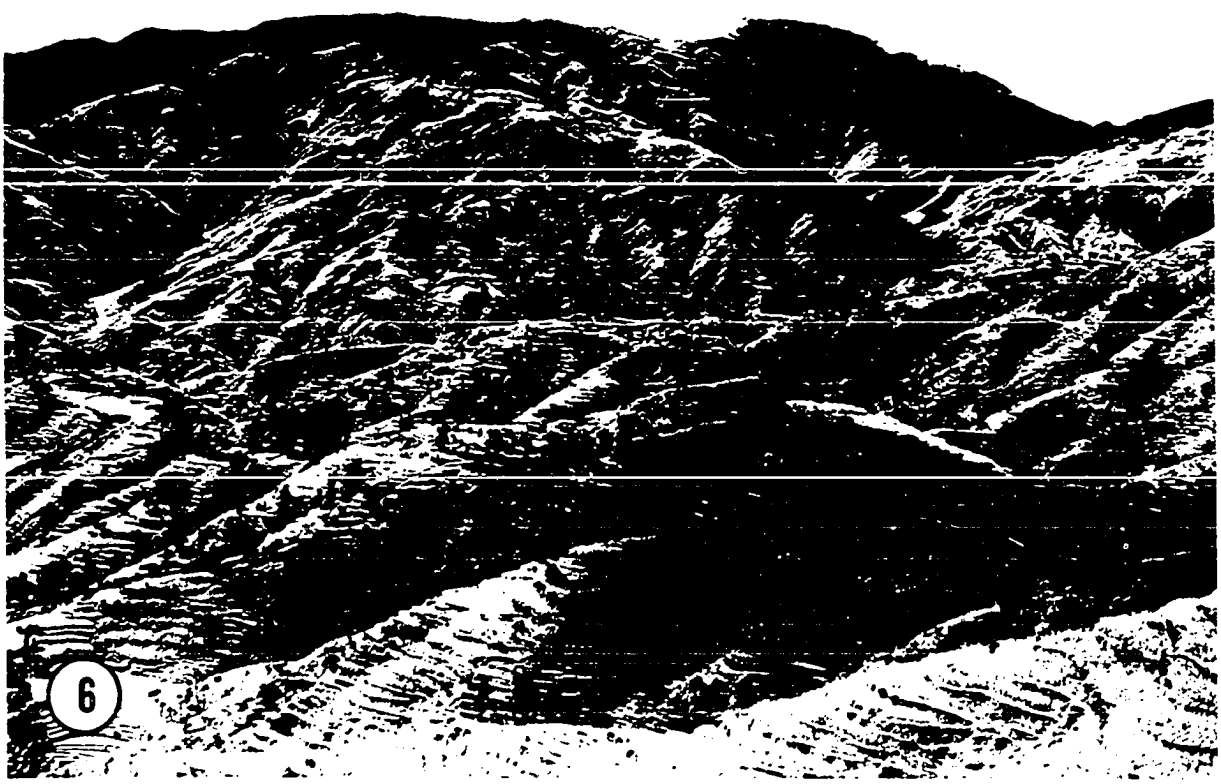
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chir pine (Pinus roxburghii) at middle altitudes (700 to 1350 m). Quercus incana - Quercus lanuginosa forests are widespread above the pine belt (Stainton 1972).

The Mahabharat Lekh

The Mahabharat Lekh, or middle Himalayas, lying to the north of the duns, are an intricate array of high ranges (1300 to 4000 m) extending the length of Nepal. This system, lying between the inner Himalayas and Siwalik hills, averages 80 km in width. It is cut by deep ravines and, because of the rugged terrain, only the lower slopes support a dense human population (Fig. 6). The southern slopes are generally too steep to maintain a soil cap for the growth of trees. The northern slopes are less steep and support dense stands of vegetation.

The Mahabharats represent a temperate climatic region with a cool, humid climate. The forests consist of a mixture of many species, chiefly pine, larch, oak, rhododendron, poplar, walnut, alder and magnolia and fir. The dominant species in the eastern Mahabharat forests are oak, magnolia, larch and pine. Fairly extensive pine forests still exist in the western sector.

The Mahabharat forests are divided into lower, middle and upper zones. At lower altitudes (1360 to 1820 m), Pinus wallichiana, P. roxburghii, Quercus sp., Acer sp., Castanopsis indicus and Pyrus sp. are the dominant species.

At middle altitudes (1820 to 3030 m), Quercus semecarpifolia, Q. incana, Juglans regia, Alnus nepalensis, Salix sp., Magnolia sp., Cedrus deodora, Picea sp., Abies sp., Pinus excelsa, Berberis sp., Rubus sp. and Rhododendron arboreum are found. Epiphytic orchids and ferns abound in these forests. In the upper zone (3000 to 3600 m), the forests consist of fir (Abies spectabilis) mixed with birch (Betula utilis) (Bhatt 1964). Stainton (1972) listed 29 species of Rhododendron for Nepal, of which the majority occur in the Mahabharat Range.

The duns

Between the Siwalik Range and the Mahabharat Lekh on the north is a series of longitudinal valleys running northwest-southeast. These valleys, called duns, are geosynclinal troughs (Wadia 1953). The largest dun valleys are the Dang in the west and the Rapti and Chitwan valleys in the central region. The Rapti and Chitwan valleys, commonly called the Rapti Dun, are joined. These wide valleys range from 300 to 1370 m. The tropical monsoon climate is similar to that of the Terai.

The nearly treeless Dang Valley (Fig. 7) has been extensively cultivated for centuries. Clumps of bamboo and mangoes are the only prevalent trees on this broad, flat plain. Sal forests still exist at the northern edge of the valley, but these areas are rapidly being cut and burned over

Fig. 7. The heavily cultivated Dang Dun; Darakhuti, Dang Deokhuri District (750 m).

Fig. 8. The forested Rapti Dun; Bhimliya, Chitwan District (175 m).


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for farmland.

In the Rapti Dun (Fig. 8), the largest of these valleys, two major rivers, the Narayani and the Rapti, drain southwestward through the region and eventually join the Great Gandak River in India. The area is heavily clothed in deciduous forests similar to those described for the Terai: sal, mixed and riparian. Another distinct vegetation is the tall elephant grass complex (Saccharum sp., Cymbopogon sp., and Bothriochloa sp.) that grows along rivers and in disturbed areas. Heavy agriculture has denuded the area of much of its original forest.

The midlands

The midlands, the zone in which the Kathmandu Valley lies, is situated between the Mahabharat Lekh to the south and the inner Himalayas to the north. This zone, with elevations varying from 600 to 4000 m, is characterized by more gentle terrain and a temperate climate. The midlands support the heaviest human population. Most of the hillsides are denuded and are either terraced for cultivation or heavily grazed.

This region could be termed an anthropogenic zone (Hassinger 1968). By intermittent or continual grazing of domestic livestock, gathering vegetation for fuel or fodder and cultivating the hillsides, man has modified the environment. Many species of plants and animals have been eliminated

and most of the trees growing around the fields and villages have been planted. Surviving oak and rhododendron forests within reach of villages have been pruned heavily for fodder and firewood, but secondary growth has reclaimed abandoned fields. Rice, wheat, millet and corn are the principal crops of the area. Buckwheat and potatoes are grown at higher elevations (2400 to 3400 m).

The inhospitable greater Himalayas to the north and the malarious jungles of the Terai and Siwaliks to the south have concentrated the majority of the population in the midlands. The average width of the region is 60 to 100 km. Hagen (1961) separates this area into nine natural divisions based on the wide valleys of the large rivers that transverse this region. Stainton (1972) divides the area into the west, east and central midlands.

The west midlands

The west midlands lies between the Kumaon border and the Kali Gandaki River (Karan 1960). At lower elevations, both north and south facing slopes support Pinus roxburghii forests (900 to 2000 m), while Quercus incana and Q. lanuginosa forests grow between 1300 and 2400 m. Quercus semecarpifolia occurs above 2400 m and Abies spectabilis is found around 3000 m. Betula utilis is widespread above 3300 m (Stainton 1972).

Aesculus, Juglans and Acer occur along streams. Pinus

excelsa forests are widespread around Rara Tal, Mugu District (Fig. 9). Two other conifers found in the area are Cedrus deodora and Picea smithiana. Pinus excelsa, Juniperus wallichiana and Ephedra sp. are common around Dhorpatan. Tsuga dumosa forests are fairly widespread between 2100 and 3000 m. A few Rhododendron forests are found in the Jumla area. Rice is cultivated at lower elevations (900 to 1900 m) with barley and winter wheat grown at higher elevations (2100 to 3000 m). Rosa sp., Cornus sp. and Jasminum sp. grow along waterways and around cultivated lands.

The central midlands

This section of the country lies between the Kali Gandaki River on the west and the Arun-Kosi watershed to the east (Karan 1960). In most parts of the central midlands, western forest types are present on southern exposures and eastern forest types prevail on northern slopes.

The western forest type is composed of Pinus roxburghii (900 to 2000 m), Quercus incana and Q. lanuginosa (1900 to 2400 m), Q. semecarpifolia (2400 to 3000 m), with Betula utilis and Abies spectabilis growing at higher elevations (3200 m). Temperate mixed broadleaf forests of Acer, Magnolia, Osmanthus and Ilex sp. occur along streams. Wet ravines and gullies are overgrown with Alnus nepalensis.

Forest types typical of the east midlands found in the central midlands are: Schima - Castanopsis (1200 to 1800 m),

Fig. 9. The pine forests of the western midlands near Rara Lake, Mugu District (2875 m).

Fig. 10. The oak-rhododendron forests typical of the central and eastern midlands; Melumche, Sindu District (2390 m).


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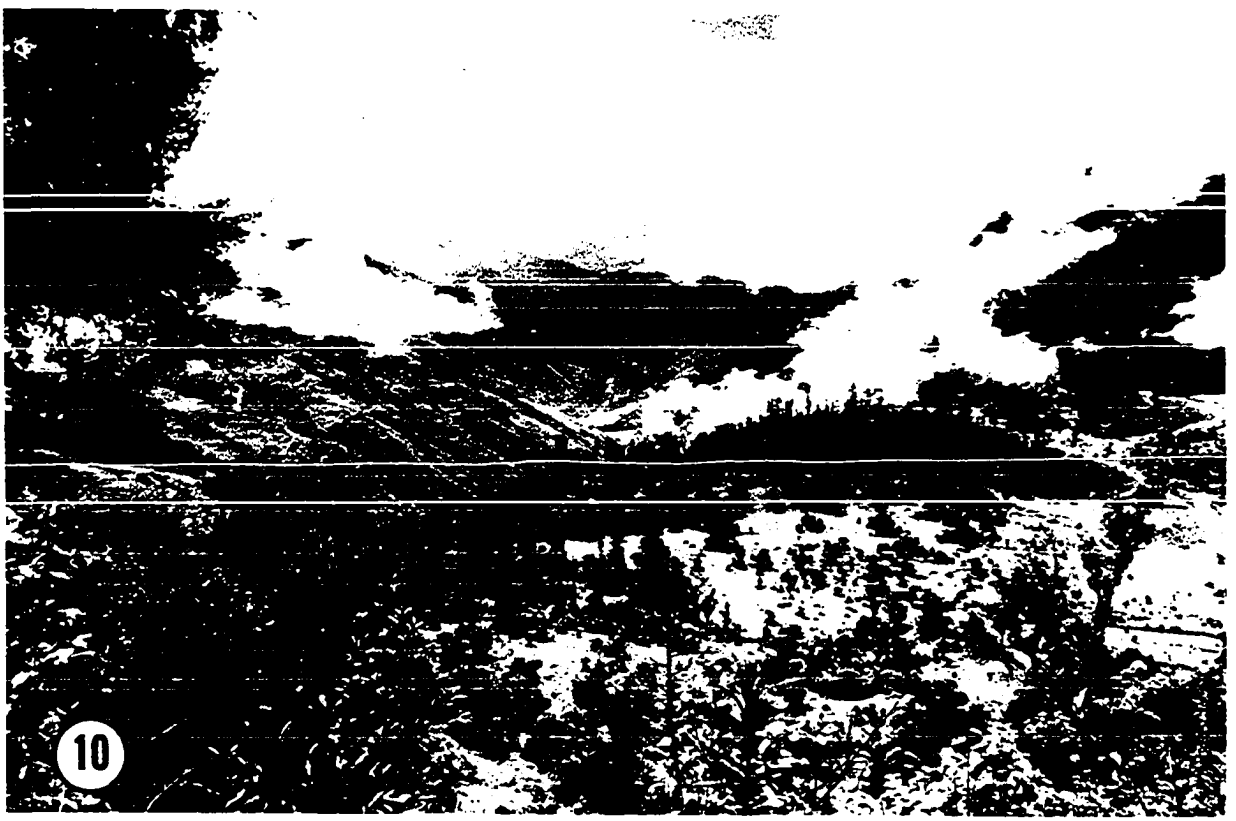
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Michelia - Laurel - Lithocarpus (1500 to 2100 m) and Quercus - Rhododendron (2100 to 2400 m) (Fig. 10). Tsuga dumosa forests are dominant from 2100 to 3300 m, interspersed with homogenous stands of Rhododendron sp.

Sal and subtropical deciduous hill forests occur in some of the lower valleys such as Trisuli, Nuwakot District. Dalbergia sissoo and Acacia catechu also grow along the rivers in these low-lying valleys (600 to 1200 m).

The east midlands

This section is bordered on the west by the Arun-Kosi watershed and by the Sikkim-Darjeeling border to the east (Karan 1960). The east midlands are heavily populated and large tracts of the original forests have been destroyed. Schima-Castanopsis forests are widespread at low elevations and are succeeded (from 1500 to 2100 m) by temperate broad-leaved forests composed of Lithocarpus, Quercus glauca, Michelia sp. and many species of the laurel family. Quercus lamellosa is found up to 2400 m. The upper temperate mixed forests of Abies spectabilis and Tsuga dumosa grow on the higher slopes (Stainton 1972). In wet, shady places sub-tropical, semi-evergreen, hill forests prevail, in which tree ferns and Pandanus furcatus are prominent.

The Inner Himalayas

The inner or greater Himalayas comprise the zone of

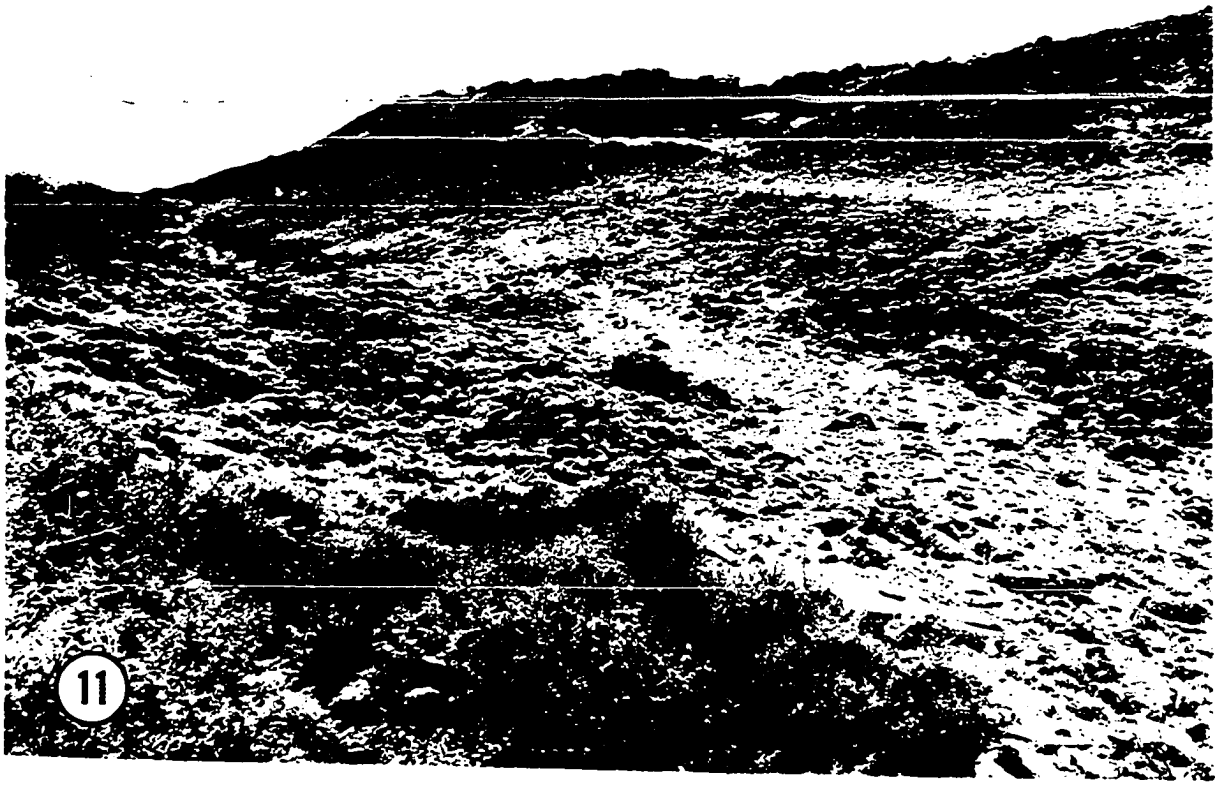
highest elevation (3600 to 8800 m) with nine peaks towering over 8000 m. In this zone, elevated plateaus and high mountain ranges are separated from one another by great depressions. The inner Himalayas rise abruptly north of the midlands, forming a steep, rugged barrier along Nepal's northern border.

Rivers have eroded wide valleys in the greater Himalayas. These valleys run east and west, parallel to the strike of the mountains. From west to east, the large valleys of the inner Himalayas are: Humla, Mugu, Langu, Thakkhola, Manang, Kutang, Kyirong, Rongshar, Khumbu and Karma (Hagen 1961). They range in elevation from 2400 m to more than 5000 m. Stainton (1972) has charted the location of these inner valleys.

Glaciers still exist in the high Himalayas, but they are a mere remnant of those which flourished in the past. The inner Himalayas have a characteristic glaciated appearance and the valleys are filled with moraines and glacial debris. Terminal moraines are now covered with alpine grasses and these areas constitute subalpine and alpine regions (Fig. 11). The tree line lies between 3600 to 3900 m and extends to 4500 m in some sections of the east. Stands of Pinus excelsa mixed with spruce (Picea morinda) and fir (Abies pindrow) occur from 2700 to 3000 m (Fig. 12). These forests give way to cypress (Cupressus torulosa) and junipers (Juniperus squamata). Birch (Betula utilis) grows near the tree line (Karan 1960).

Fig. 11. The alpine meadows of the inner Himalayas, central Nepal; Dhukphu, Sindu District (3865 m).

Fig. 12. The evergreen forests of the inner Himalayas near Namche Bazaar, Solukhumbu District (2750 m).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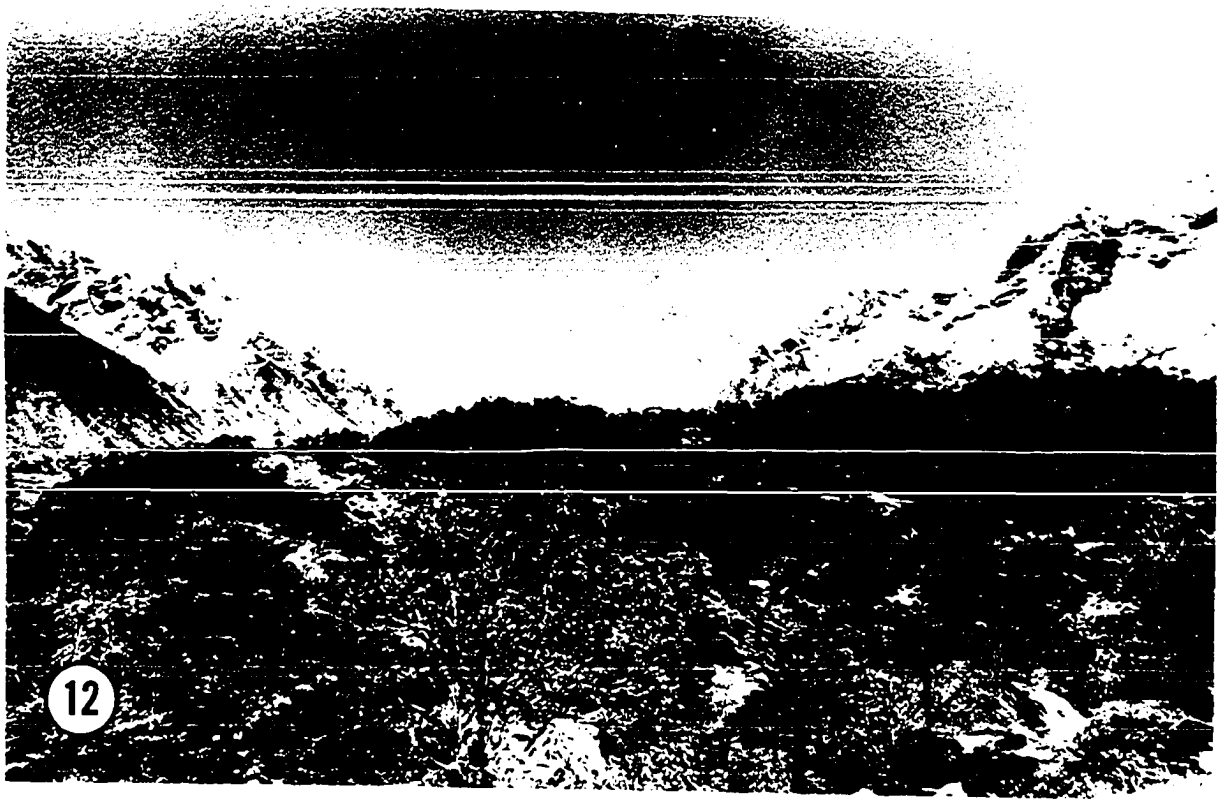
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The upper region of the alpine zone (4200 to 4600 m) consists of stunted bushes of Rhododendron and Salix. Some herbaceous plants found in the alpine region are Potentilla, Primula, Gentiana and Saxifraga.

Potatoes and buckwheat are the principal crops grown in these high valleys, and sheep, yaks and zhumos are pastured on the high alpine meadows.

The Tibetan Plateau

The Tibetan marginal mountains mark the southern edge of the true Tibetan Plateau. They occur along the northernmost border of Nepal (Hagen 1961), reaching 6000 to 7000 m and having the arid climate typical of the Tibetan Plateau proper. The Tibetan Zone (Mustang District) lies north of the axis of the great Himalayan range. Only north of Jomosom is the edge of this region encountered. Here the mountains slope gently from south to north (Fig. 13).

The high alpine desert is largely devoid of vegetation except for a few trees and patches of xerophytic, thorny bushes (Fig. 14). Strong winds blow continuously throughout the area. Along the valley floor, the vegetation consists of Sophora, Lonicera and Caragana with a few Prunus growing around irrigated land. Stunted forests of Juniperus wallichiana grow on the exposed southern slopes and Ephedra and Artemisia are found along the flood plain of the Kali Gandaki River. Winter wheat is the principal cultivated crop.

Fig. 13. The alpine desert biotope of the Tibetan Plateau; Jomosom, Mustang District (2650 m).

Fig. 14. The xerophytic vegetation of the Tibetan Plateau near Jomosom, Mustang District (2650 m).


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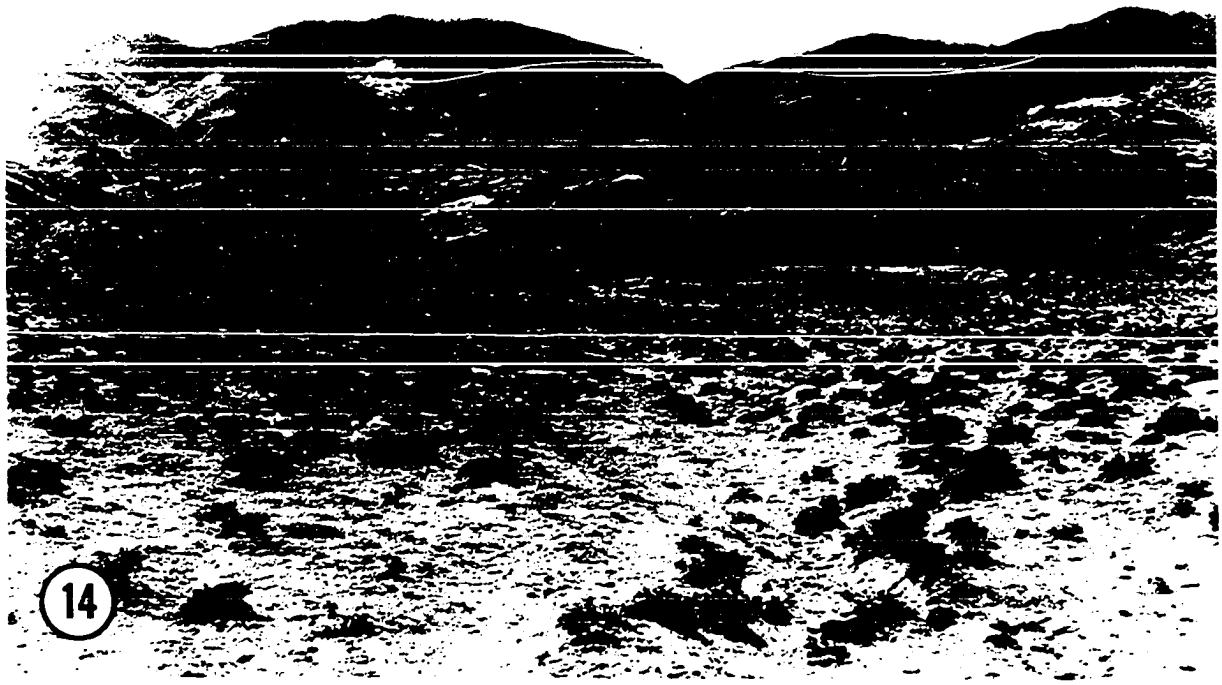

14

MATERIALS AND METHODS

Personnel

The Nepal ectoparasite field team consisted of me, my wife Marleane, a Nepalese assistant, Mani K. Lama and a cook, Ang Kami Sherpa. I served as liaison between the project and His Majesty's Government, Ministry of Health, and conducted the field research. Mr. Lama acted as interpreter and assisted in the preparation of museum specimens. My wife planned and organized all supplies and photographed habitat sites and mammal specimens. The expedition engaged additional local porters, guides and camp help as needed at each major collecting locality.

Procedures

The principal goal of the Nepal Ectoparasite Program was to collect a geographically and ecologically representative sample of high altitude mammals and ectoparasites from Nepal. Representative ecosystems were sampled by establishing a series of collecting sites, each site unique in that it was in a geographically, topographically or floristically different area.

Field trips were planned to last approximately two months. Transportation to each site varied. Most localities in the Terai and duns were accessible by jeep or air. Heli-

copter and STOL aircraft were employed to reach destinations in the midlands. Human porters and yaks were used to transport gear to the inner Himalayas and the Tibetan Plateau.

Collection Methods

Mammals and birds were collected by various means to determine their kinds, distribution and interrelationships with the different life zones and ectoparasite load. Museum Special snap traps baited with peanut butter and rolled oats were used to capture small rodents and insectivores. Steel traps baited with meat were employed to take small and medium-sized carnivores. A 12-gauge shotgun and a .22 rifle were used to obtain foxes, jackals, cats, lagomorphs and game birds. Large carnivores and game animals were taken with a 30-06 rifle. Japanese mist nets were suspended over streams and clearings to snare birds and bats. A predator call was used to lure carnivores within gun-shot range. Night-hunting with the aid of a spotlight proved productive for canids, felids, viverrids and lagomorphs.

At each collection site, traps and nets were set in selected habitats. They were checked three times daily (dawn, dusk and night) for hosts. Each host was placed in a clean cotton sack and the sack was secured to prevent the loss of ectoparasites.

Ectoparasites were collected from mammals by vigorously brushing the host over a deep, white plastic pan. Each host

was then examined carefully around the eyes and ears for ticks, the flanks and belly for fleas, and the urogenital area for mites. The local livestock was also checked for ectoparasites. Crevices around bat caves and poultry roosts were checked for argasid ticks. Bat guano was examined for fleas and larval and nymphal stages of ticks. A white flannel cloth was employed to flag for ticks along game trails, shrubbery and vegetation. Bird and mammal nests were examined for fleas, mites and ticks.

From each collection site a series of representative study skins of mammals and birds was prepared for subsequent study. Small birds and bats were preserved in 70% ethyl alcohol (ETOH) or 10% formalin. For large mammals, flat skins were prepared and the skulls saved. The following external measurements (in mm) were recorded for mammals: total length, tail length, hind foot and ear. The breeding condition of each mammal was also checked. Males were examined for enlarged testes and females for embryos, uterine scars and signs of lactation. Ecological notes were recorded on the habitat and photographs were taken of collection sites and host mammals.

Analysis of Data

The host-ectoparasite data were numerically analyzed (see Sneath and Sokal 1962; Sokal and Sneath 1963) to determine: (1) host preference and specificity, (2) host specificity of

ectoparasites (70% criterion), (3) total number of ectoparasites collected and (4) mammals collected from each life zone. Cluster techniques (Sneath and Sokal 1973) were employed to determine the host affinity between geographic realms and life zones. Standard statistical methods were used to derive the mean, range, standard deviation and coefficient of variance for mammal body measurements.

SPECIAL TERMS

The following words used in the text require definition:

Duns - Synclinal depressions (valleys) within the Siwalik formation.

Khola - River

Lekh - Mountain Range

Shekari - Local Hunter

Tal - Lake

Terai - The northern extension of the Gangetic Plain, or the malarious lowland belt of Nepal. It varies in width from 25 to 36 km and in elevation from 100 to 300 m.

Zhumo - Female offspring of the cow/yak cross

Zhupiak - Male offspring of the cow/yak cross

COLLECTION SITE GAZETTEER

The exact location and spelling of Nepalese place names are often difficult because of differing ways of transliterating names from Nepali to Latin characters, as well as the application (on different maps in the literature) of various names to one locality or one name to several localities. This real or potential ambiguity is compounded by the instability of zonal and district names and boundaries. Therefore, to make the exact location of collection records more certain, each collection site is designated by a place name, a district name, map coordinates and an altitudinal range. In addition, a number is placed beside each place name which corresponds to each collection site (Fig. 1, folding map). When several place names are located close to each other, they are placed under one collection site.

This gazetteer is limited to collection sites from which the Nepal Ectoparasite Program and the Arun Valley Wildlife Expedition secured host-ectoparasite information. The place names and coordinates employed are from maps compiled by the Army Map Service (RMBM), Corps of Engineer, U.S. Army, Washington, D.C., Edition 2-AMS, 1955. India and Pakistan 1:250,000, Series U502.

	Place Name	District	Map Co-ordinates	Altitude (m., approx.)
1	Bahwanipur	Banke	27°57'N, 81°47'E	153
2	Bajapur	Banke	28°02'N, 81°51'E	236
3	Banepa	Kabhre (Palanchok)	27°37'N, 85°34'E	1180
4	Batar	Nuwakot	27°53'N, 85°10'E	1622
5	Bathang	Mustang	28°45'N, 83°45'E	2950
6	Belumche	Sindu	27°56'N, 85°29'E	2270
7	Bhadrapur (Chandra Garhi)	Jhapa	26°37'N, 88°02'E	221
8	Bharatpur	Chitwan	27°35'N, 84°11'E	182
9	Bhimliya (Tiger Tops)	Chitwan	27°32'N, 84°13'E	177
10	Bijauri	Dang Deokhuri	28°07'N, 82°22'E	737
11	Charang	Mustang	29°04'N, 83°56'E	3687
12	Chautha	Jumla	29°27'N, 82°06'E	2507
13	Chelegaon	Mustang	28°55'N, 83°50'E	2950
14	Chhukgaon	Mustang	28°54'N, 83°50'E	2802
15	Chobar	Kathmandu	27°40'N, 85°17'E	1327
16	Dandigaon	Bajhang	29°33'N, 81°11'E	1770
17	Darakhuti	Dang Deokhuri	28°09'N, 82°17'E	773
18	Devighat	Nuwakot	27°56'N, 85°09'E	752
19	Dhangarhi	Kailali	28°40'N, 80°34'E	200
20	Dhobato	Sindu	27°58'N, 85°29'E	2655
21	Dhorpatan	Dolpa	28°33'N, 83°05'E	2640
22	Dhukphu	Sindu	28°06'N, 85°35'E	3864
23	Dubi Karka	Ramechap	27°44'N, 86°23'E	3602
24	Duglha	Solukhumbu	27°56'N, 86°51'E	4469
25	Dumkhauli	Nawal Parasi	27°34'N, 84°05'E	143
26	Ghilinggaon	Mustang	28°59'N, 83°51'E	3687
27	Godavri	Lalitpur	27°37'N, 85°25'E	1475
28	Gokarna (King's Forest)	Kathmandu	27°44'N, 85°24'E	1327
29	Gosainkund Lakes	Nuwakot	28°03'N, 85°25'E	4056

	Place Name	District	Map Co-ordinates	Altitude (m., approx)
30	Gosainkund Pass	Nuwakot	28°04'N, 85°26'E	4285
31	Gulari	Banke	28°04'N, 81°45'E	124
32	Hitaura	Makwanpur	27°27'N, 85°04'E	549
33	Jomosom	Mustang	28°46'N, 83°45'E	2652
34	Jumla	Jumla	29°17'N, 82°11'E	2301
35	Kadari (and surrounding)	Sindu	27°56'N, 85°56'E	2270-2375
36	Kakani	Nuwakot	27°49'N, 85°16'E	2248
37	Kalapani	Mustang	28°39'N, 83°37'E	2389
38	Kaldapeh	Sindu	28°03'N, 85°35'E	2478
39	Kailali	Kailali	28°44'N, 80°35'E	147
40	Kathmandu	Kathmandu	27°43'N, 85°18'E	1302-1350
41	Khangjung	Rasuwa	28°11'N, 85°22'E	2212
42	Khumjung	Solukhumbu	27°49'N, 86°44'E	3555
43	Kildonphu	Sindu	28°08'N, 85°35'E	4056
44	Kyangjin Ghyang	Rasuwa	28°12'N, 85°35'E	3614
45	Langtang (and Langtang Valley)	Rasuwa	28°13'N, 85°23-25'E	3290-3687
46	Lobuche	Solukhumbu	27°57'N, 86°51'E	4661
47	Lukla	Solukhumbu	27°41'N, 86°44'E	2699
48	Lupra	Mustang	28°48'N, 83°47'E	3540
49	Madhuban	Bara	27°04'N, 85°06'E	65
50	Mahadeva	Banke	28°13'N, 81°46'E	221
51	Maharang Pass	Mustang	29°06'N, 83°55'E	3835
52	Maharigaon	Jumla	29°21'N, 82°23'E	3060
53	Mahendranagar (#1)	Kanchanpur	28°58'N, 80°13'E	212
54	Mahendranagar (#2)	Banke	28°06'N, 81°49'E	147
55	Mani Gayru	Sindu	27°56'N, 85°30'E	2360
56	Melumche (and surrounding)	Sindu	27°56'-28°05'N, 85°32-33'E	1770-3097
57	Muktinath	Mustang	28°48'N, 83°52'E	3466
58	Mulkharka	Sindu	27°47'N, 85°26'E	1504

	Place Name	District	Map Co-ordinates	Altitude (m., approx.)
59	Mustang (Lho Mantang)	Mustang	29°12'N, 83°57'E	3687
60	Nangetanti	Mustang	28°22'N, 83°44'E	2507
61	Naura	Bajhang	29°33'N, 81°17'E	1770
62	Nepalganj	Banke	28°04'N, 81°37'E	118
63	Pangboche	Solukhumb:	27°52'N, 86°47'E	3791
64	Patan	Kathmandu	27°41'N, 85°20'E	1327
65	Phulung Ghyang	Nuwakot	28°07'N, 85°22'E	2360
66	Pithlekh	Bajhang	29°35'N, 81°12'E	2139
67	Ramche	Nuwakot	28°03'N, 85°13'E	1622
68	Rara Lake (and surrounding)	Mugu	29°34'N, 82°05'E	2876
69	Serdingma	Ramechap	27°39'N, 86°23'E	2950
70	Shamsherganj	Banke	28°05'N, 81°47'E	147
71	Simri	Bara	27°07'N, 85°14'E	89
72	Singasing	Kathmandu	27°47'N, 85°26'E	1711
73	Sisaiya	Kanchanpur	28°55'N, 80°22'E	214
74	Sundarijal	Kathmandu	27°46'N, 85°28'E	1475
75	Surkemela	Bajhang	29°35'N, 81°09'E	2479
76	Syahru	Nuwakot	28°09'N, 85°23'E	2168
77	Syaburbensi	Rasuwa	28°11'N, 82°22'E	1475
78	Tamaspur	Nawal Parasi	27°34'N, 83°57'E	94
79	Tarke Ghyang	Sindu	28°02'N, 85°34'E	2354
80	Thare Pati (Uring Ghyang)	Sindu	28°01'N, 85°30'E	3385
81	Thodung	Ramechap	27°37'N, 86°22'E	2979
82	Trisuli Bazaar	Nuwakot	27°56'N, 85°08'E	546
83	Bharabise	Sankhuwasabha	27°26'N, 87°19'E	515
84	Chainpur	Sankhuwasabha	27°18'N, 87°19'E	1182
85	Chepua (and surrounding)	Sankhuwasabha	27°40-46'N, 87°21-24'E	1515-2273

	Place Name	District	Map Co-ordinates	Altitude (m., approx.)
86	Kasua Khola	Sankhuwasabha	27°35-58'N 85°15-17'E	1515-4030
87	Kimathangka	Sankhuwasabha	27°50'N, 87°25'E	2667
88	Num (and surrounding)	Sankhuwasabha	27°20-40'N, 87°16-19'E	1970-3455
89	Tumlingtar	Sankhuwasabha	27°17'N, 87°13'E	455

CHECK-LIST OF THE RECENT MAMMALS

The following is a list of terrestrial mammals belonging to 10 orders, 25 families, 78 genera and 144 species and subspecies collected or reported from Nepal. Eighteen other species asserted to occur in Nepal are not included.

The arrangement of orders follows that of Simpson (1945) and family, generic and specific names those of Ellerman and Morrison-Scott (1966). An asterisk by a species denotes that it was collected or sighted for the first time from Nepal.

Order Insectivora

Family Tupaiidae

Tupaia glis lepcha Thomas, 1922

Family Talpidae

Talpa micrura micrura Hodgson, 1841

Family Soricidae

**Sorex minutus thibetanus* Kastschenko, 1905
Sorex cylindricauda cylindricauda Milne-Edwards, 1872
Sorex cylindricauda nepalensis Weigel, 1969
Soriculus nigrescens nigrescens (Gray, 1842)
Soriculus caudatus caudatus (Horsfield, 1851)
Soriculus caudatus soluensis Weigel, 1969
Soriculus gruberi Weigel, 1969
Soriculus leucops (Horsfield, 1855)
Suncus murinus caerulescens (Shaw, 1800)
Suncus murinus soccatus (Hodgson, 1845)
Suncus murinus tytleri (Blyth, 1859)
**Suncus etruscus pygmaeoides* (Anderson, 1877)
**Suncus stoliczkanus stoliczkanus* (Anderson, 1877)
**Crocidura horsfieldi horsfieldi* (Tomes, 1856)
**Crocidura attenuata rubricosa* Anderson, 1877
**Crocidura* sp.

Chimmarogale platycephala himalayica (Gray, 1842)
*Nectogale elegans sikhimensis de Winton & Styan, 1899

Order Primates

Family Cercopithecidae
Macaca mulatta mulatta (Zimmermann, 1780)
Macaca assamensis pelops (Hodgson, 1840)
Presbytis entellus schistaceus (Hodgson, 1840)
Presbytis entellus achilles (Pocock, 1928)

Order Pholidota

Family Manidae
Manis pentadactyla aurita Hodgson, 1836

Order Lagomorpha

Family Leporidae
Lepus nigricollis ruficaudatus Geoffroy, 1826
Lepus oiostolus oiostolus Hodgson, 1840
Caprolagus hispidus (Pearson, 1839)

Family Ochotonidae
Ochotona roylei roylei (Ogilby, 1839)
Ochotona roylei wardi Bonhote, 1904
Ochotona macrotis wollastoni Thomas and Hinton, 1922
*Ochotona daurica curzoniae (Hodgson, 1858)
Ochotona angdawai Biswas and Khajuria, 1955
*Ochotona sp.

Order Rodentia

Family Sciuridae
*Belomys pearsoni pearsoni (Gray, 1842)
Petaurista elegans caniceps (Gray, 1842)
Petaurista elegans gorkhali (Lindsay, 1929)
Petaurista petaurista albiventer (Gray, 1834)
Petaurista magnificus (Hodgson, 1836)
Hylopetes alboniger alboniger (Hodgson, 1836)
Callosciurus pygerythrus lokroides (Hodgson, 1836)
Callosciurus macclellandi macclellandi (Horsfield, 1839)
Dremomys lokriah (Hodgson, 1836)
Funambulus pennanti pennanti Wroughton, 1905
Ratufa bicolor gigantea (M'Clelland, 1839)
Marmota bobak himalayana (Hodgson, 1841)

Family Hystricidae
Hystrix hodgsoni hodgsoni (Gray, 1847)
Hystrix indica indica Kerr, 1792

Family Rhizomyidae
Cannomys badius badius (Hodgson, 1842)

Family Muridae
Vandeleuria oleracea dumeticola (Hodgson, 1845)
*Vandeleuria oleracea modesta Thomas, 1914
Apodemus flavicollis gurkha Thomas, 1924
Apodemus sylvaticus wardi (Wroughton, 1908)
Millardia meltada pallidor Ryley, 1914
Rattus rattus ssp.
Rattus rattus brunneus (Hodgson, 1845)
Rattus rattus brunneusculus (Hodgson, 1845)
Rattus nitidus nitidus (Hodgson, 1845)
Rattus turkestanicus (Satunin, 1903)
Rattus niviventer niviventer (Hodgson, 1836)
Rattus fulvescens fulvescens (Gray, 1847)
Rattus eha eha (Wroughton, 1916)
Mus musculus ssp.
Mus musculus homourus Hodgson, 1845
Mus musculus urbanus Hodgson, 1845
Mus booduga booduga (Gray, 1837)
Mus cervicolor cervicolor Hodgson, 1845
Golunda ellioti myothrix (Hodgson, 1845)
Bandicota bengalensis bengalensis (Gray & Hardwicke, 1833)
Bandicota indica nemorivaga (Hodgson, 1836)
Nesokia indica indica (Gray and Hardwicke, 1832)
*Tatera indica indica (Hardwicke, 1807)
Alticola stoliczkanus stoliczkanus (Blanford, 1875)
Alticola stracheyi (Thomas, 1880)
*Pitymys leucurus leucurus (Blyth, 1863)
Pitymys sikimensis (Hodgson, 1849)

Order Cetacea

Family Platanistidae
Platanista gangetica (Lebeck, 1801)

Order Carnivora

Family Canidae
Canis lupus chanco Gray, 1863
Canis aureus indicus Hodgson, 1833
Vulpes vulpes montana (Pearson, 1836)
Vulpes bengalensis (Shaw, 1800)

*Vulpes ferrilata Hodgson, 1842
Cuon alpinus primaevus (Hodgson, 1833)

Family Ursidae
Selenarctos thibetanus thibetanus (Cuvier, 1823)
Melursus ursinus ursinus (Shaw, 1791)

Family Procyonidae
Ailurus fulgens fulgens Cuvier, 1825

Family Mustelidae
Martes foina intermedia (Severtzov, 1873)
Martes flavigula flavigula (Boddaert, 1785)
Mustela altaica temon Hodgson, 1857
Mustela kathiah kathiah Hodgson, 1835
Mustela sibirica subhemachalana Hodgson, 1837
Mustela sibirica canigula Hodgson, 1842
Mustela strigidorsa Gray, 1853
Mellivora capensis inaurita (Hodgson, 1836)
Melogale personata nipalensis (Hodgson, 1836)
Arctonyx collaris collaris Cuvier, 1825
Lutra lutra monticola Hodgson, 1839
Lutra lutra aurobrunnea Hodgson, 1839
Lutra perspicillata perspicillata Geoffroy, 1826
Aonyx cinerea concolor (Rafinesque, 1832)

Family Viverridae
Viverra zibetha zibetha Linnaeus, 1758
Viverricula indica wellsi Pocock, 1933
Prionodon pardicolor pardicolor Hodgson, 1842
Paradoxurus hermaphroditus bondar (Desmarest, 1820)
Paradoxurus hermaphroditus pallasi Gray, 1832
Paguma larvata grayi (Bennett, 1835)
Paguma larvata neglecta Pocock, 1934
Herpestes auropunctatus auropunctatus (Hodgson, 1836)
Herpestes edwardsi nyula (Hodgson, 1836)
Herpestes urva (Hodgson, 1836)

Family Hyaenidae
*Hyaena hyaena hyaena (Linnaeus, 1758)

Family Felidae
Felis chaus affinis Gray, 1830
*Felis lynx isabellina Blyth, 1847
Felis marmorata charltoni Gray, 1846
Felis temmincki temmincki Vigors and Horsfield, 1827
Felis bengalensis horsfieldi (Gray, 1842)
Felis viverrina Bennett, 1833
Neofelis nebulosa macrosceloides (Hodgson, 1853)
Panthera pardus fusca (Meyer, 1794)

Panthera tigris tigris (Linnaeus, 1758)
Panthera uncia (Schreber, 1776)

Order Proboscidea

Family Elephantidae
Elephas maximus indicus Cuvier, 1797

Order Perissodactyla

Family Rhinoceratidae
Rhinoceros unicornis Linnaeus, 1758

Order Artiodactyla

Family Suidae
Sus scrofa cristatus Wagner, 1839
Sus salvanius (Hodgson, 1847)

Family Tragulidae
*Tragulus meminna (Erxleben, 1777)

Family Cervidae
Moschus moschiferus moschiferus Linnaeus, 1758
Muntiacus muntjak vaginalis (Boddaert, 1785)
Axis axis axis (Erxleben, 1777)
Axis porcinus porcinus (Zimmermann, 1780)
Cervus unicolor niger Blainville, 1816
Cervus duvauceli duvauceli Cuvier, 1823

Family Bovidae
Tetracerus quadricornis (Blainville, 1816)
Boselaphus tragocamelus (Pallas, 1766)
Bos gaurus gaurus H. Smith, 1827
Bos grunniens grunniens Linnaeus, 1766
Bubalus bubalis bubalis (Linnaeus, 1758)
Antilope cervicapra cervicapra (Linnaeus, 1758)
Capricornis sumatraensis thar (Hodgson, 1831)
Nemorhaedus goral goral (Hardwicke, 1825)
Nemorhaedus goral hodgsoni Pocock, 1908
Hemitragus jemlahicus jemlahicus (H. Smith, 1826)
Pseudois nayaur nayaur (Hodgson, 1833)
*Ovis ammon hodgsoni Blyth, 1841

ACCOUNTS OF SPECIES

This section treats 130 species of free-living terrestrial mammals, excluding bats, which are known to occur in Nepal. Included are records of 17 mammals collected for the first time in Nepal, plus the accounts of two species previously recorded but now believed to be extinct.

Each account provides the accepted scientific name, together with a citation to the original description of the species and its type locality. Major taxonomic changes, distribution, Nepal records and the Nepal Ectoparasite Program collection records are also listed.

Major Taxonomic Changes: This section provides a citation of every major taxonomic name change for each species. Specific names recorded in earlier works and which have subsequently been relegated to synonymy are also listed.

Distribution: A very approximate geographic range is given for each species. These ranges are based on records in Ellerman and Morrison-Scott (1966), Checklist of Palaearctic and Indian Mammals, and type locality records.

Nepal Records: The records are based on collections of specimens by previous expeditions and individuals. Some mammals were sighted but not collected, and some published records are imperfectly documented. Records are arranged chronologically from the earliest collection date to the most recent.

Nepal Ectoparasite Program (NEP): This lists all the records tabulated by C. O. Maser, R. M. Mitchell and the Arun Valley Wildlife Expedition (AVWE) from July 1966 to December 31, 1973.

Following this standard introduction, each account incorporates three or four of the following major headings: (1) Habitat, (2) Taxonomic notes, (3) Field notes (or in lieu of the last two headings, Discussion) and (4) Ectoparasites. The general content of these accounts is as follows:

1. Habitat: Altitudinal range, preferred life zones and biotopes are discussed briefly. Vegetational characteristics of the observed habitat are described for some species. When necessary and if possible, these data are supplemented from the literature. Special terms and life zones have been discussed and illustrated previously in the text.

2. Taxonomic notes: Species attributes which have immediate or potential systematic value and taxonomic problems created or elucidated during the present study are discussed. Reference is made to authors elucidating these taxonomic problems.

3. Field Notes: This section includes a brief description of the species, interesting notes from published records, natural history observations, collecting techniques and any other information originating from the project. Breeding biology, food preferences and behavioral aspects

are included when available.

Discussion: In cases where collections, literature records and field observations are insufficient to warrant the use of either of the foregoing two headings, the heading "Discussion" is substituted.

4. Ectoparasites: This section lists all the ectoparasites collected by the Nepal Ectoparasite Program and the Arun Valley Wildlife Expedition from each species of mammal. Ectoparasites are listed under the ordinal rank alphabetically by genus and species. Classification of the Acarina adheres to the system followed by Krantz (1970).

Nepal Distribution: With the exception of Mus musculus, distribution in Nepal is estimated and schematically illustrated for each species on the basis of previous locality records and collection data from the Nepal Ectoparasite Program. Species with limited locality data are grouped with related species.

Except for those body measurements elucidated in the text, most body measurements for mammals treated in this study are presented in Appendix I. All body measurements have been statistically analyzed by computer techniques for both male and female specimens. Tabulated measurements and abbreviations are:

Total length (TL): The greatest length from the tip of the nose-pad to the tip of the fleshy part of the tail, excluding hairs that project beyond tip.

Tail length (T): The greatest length from base to tip without terminal hairs.

Hind foot length (HF): With toes out straight, the distance from tip of longest claw to heel.

Ear length (E): From notch at bottom of ear to distal-most border of fleshy part of ear.

Color descriptions of pelage are based on standards established by Ridgway (1912) and Maerz and Paul (1950).

ORDER INSECTIVORA

Tupaia glis lepcha Thomas, 1922

Tree Shrew

1922. Tupaia belangeri lepcha Thomas. J. Bombay Nat. Hist. Soc. 28: 428.

Type locality: Narbong, near Darjeeling, India.

1966. Tupaia glis lepcha Thomas, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mammals. 2nd ed. p. 12.

Distribution: Bhutan Duars, Sikkim, Darjeeling, eastern Nepal.

Nepal Records: Worth and Shah (1969, p. 127).

Habitat: The semi-tropical forests of the eastern Himalayas from 900 to 1800 m.

Discussion: This small insectivore (TL 380-430 mm) is squirrel-like in appearance. The muzzle is elongated and lacks the conspicuous vibrissae characteristic of insectivores. The apex of the snout is naked, the ears are short and rounded and the tail is covered with long hairs. Dorsally, the fur is yellowish brown, somewhat grizzled; the lower parts are yellowish buff. There are two pairs of mammae, one inguinal and the other axillary. The dental formula is: i. 2/3; c. 1/1; pm. 3/3; m. 3/3 = 38 (Allen 1938).

Tree shrews are diurnal and arboreal, although they spend much time foraging on the ground and understory. According

to Blanford (1888), they feed mainly on insects and fruit as well as small birds and mice. Walker et al. (1964a) reported breeding throughout the year and a gestation period of 46 to 50 days. The litter size is one to four.

The only specimen of the tree shrew recorded from Nepal was taken from the Ilam District in a live trap set in a clump of bamboo (Worth and Shah 1969). Due to the effects of extensive deforestation and cultivation of the region, tree shrews are most likely rare. They are more common in the tropical forests of Darjeeling and Sikkim.

Talpa micrura micrura Hodgson, 1841

Eastern Mole

1841. Talpa micrurus Hodgson. Calcutta J. Nat. Hist. 2: 221.
Type locality: Nepal, Central and Northern Hills.

1843. Talpa cryptura Blyth. J. Asiat. Soc. Bengal 12: 177.
Type locality: Sylhet, Assam.

1858. Talpa macrura Hodgson. J. Asiat. Soc. Bengal 27: 176.
Type locality: Darjeeling, India.

1888. Talpa micrura Blanford. The Fauna Brit. India, Mamm. p. 225.
Type locality: Darjeeling, India.

Distribution: Assam, Sikkim, Darjeeling, probably eastern Nepal.

Nepal Records: Hodgson (1842a, p. 221).

Habitat: The deep bed of black vegetable mould of the tropical and subtropical forests of the eastern Himalayas.

Discussion: The eastern mole is chiefly modified for a fossorial life through specialization of the forefeet and modification of the anterior part of the body for pushing through loose soil and leaf litter. The head is tapered, external ears small or absent and neck short and muscular. There are five fingers on the forefeet and each is provided with a stout claw. The tail is extremely short, naked and completely concealed by the fur. The overall color is a uniform velvety black with a silvery gray gloss. The snout and feet are whitish or pale flesh color.

These moles inhabit tropical and subtropical forests of the eastern Himalayas and are found in humus and leaf litter. They burrow through vegetable mould and runs are not marked by mole-hills. They feed on insect larvae and earthworms contained in the litter (Blanford 1888). Little is known of their breeding habits.

Hodgson (1834b) stated that this genus is found only in the Kachar. The Kachar or juxta-Himalayan region consists of high mountains, the summits of which are buried half the year in snow.

Hodgson (1842a) also reported the only collection of T. micrura from Nepal. No fresh mole burrows were noted

during our study, and it is likely that this is an eastern Himalayan species confined to the rain forests of Darjeeling and Sikkim where there is a greater accumulation of leaf litter on the forest floors.

Sorex minutus thibetanus Kastschenko, 1905

Kastschenko's Pygmy Shrew

1905. Sorex minutus thibetanus Kastschenko. Trans. Univ. Tomsk. 27: 93.

Type locality: Tsaidam, Chinghai (Chinese Central Asia).

Distribution: Tsaidam, Chinese Central Asia, Szechuan, Tibet and northwest Nepal.

NEP: 6 specimens: Mitchell - 6.

Habitat: Drier regions and subalpine coniferous forests of the western midlands and the alpine desert biotope of the Mustang District, from 2700 to 3800 m.

Field Notes: Sorex minutus is a tiny shrew 90 to 110 mm in length. The pelage is wood brown to chocolate brown above with silvery gray sides and belly. The tail is densely clothed with fine long hairs and a pencil of bristles extends 3 to 4 mm past the tip.

The skull is low and broad, the brain case relatively large and the rostrum pointed and narrow. The dental formula is: i. 3/1; c. 1/1; pm. 3/1; m. 3/3 = 32. The teeth are

characterized by their small size and by the gradation in the shape of the unicuspids of the upper jaw. The first, second and third unicuspids are nearly equal in size, the fourth and fifth somewhat smaller. The first upper incisor is much enlarged with two cusps, one behind the other.

Four skulls were measured and the mean and extreme dimensions are: greatest length - 15.1 to 16.2; width of brain case - 6.5 to 7.2 (6.9); upper tooth row - 6.5 to 6.6 (6.55). As noted by Ellerman and Morrison-Scott (1966), the width of the skull does not exceed 8 mm and the total length of the skull in most cases is under 16 mm.

Since only six specimens were collected, little information was obtained concerning their food preference and breeding biology. A female collected on 28 May contained six embryos averaging 6.6 mm in length.

At Dhorpatan and Maharigaon Sorex minutus was collected in association with Soriculus caudatus and S. nigrescens. These two species are more or less semicommensal while the pygmy shrew is strictly feral.

ECTOPARASITES

Siphonaptera:	Palaeopsylla helenae Paradoxopsyllus magnificus
Ixodoidea:	Anomalohimalaya lama

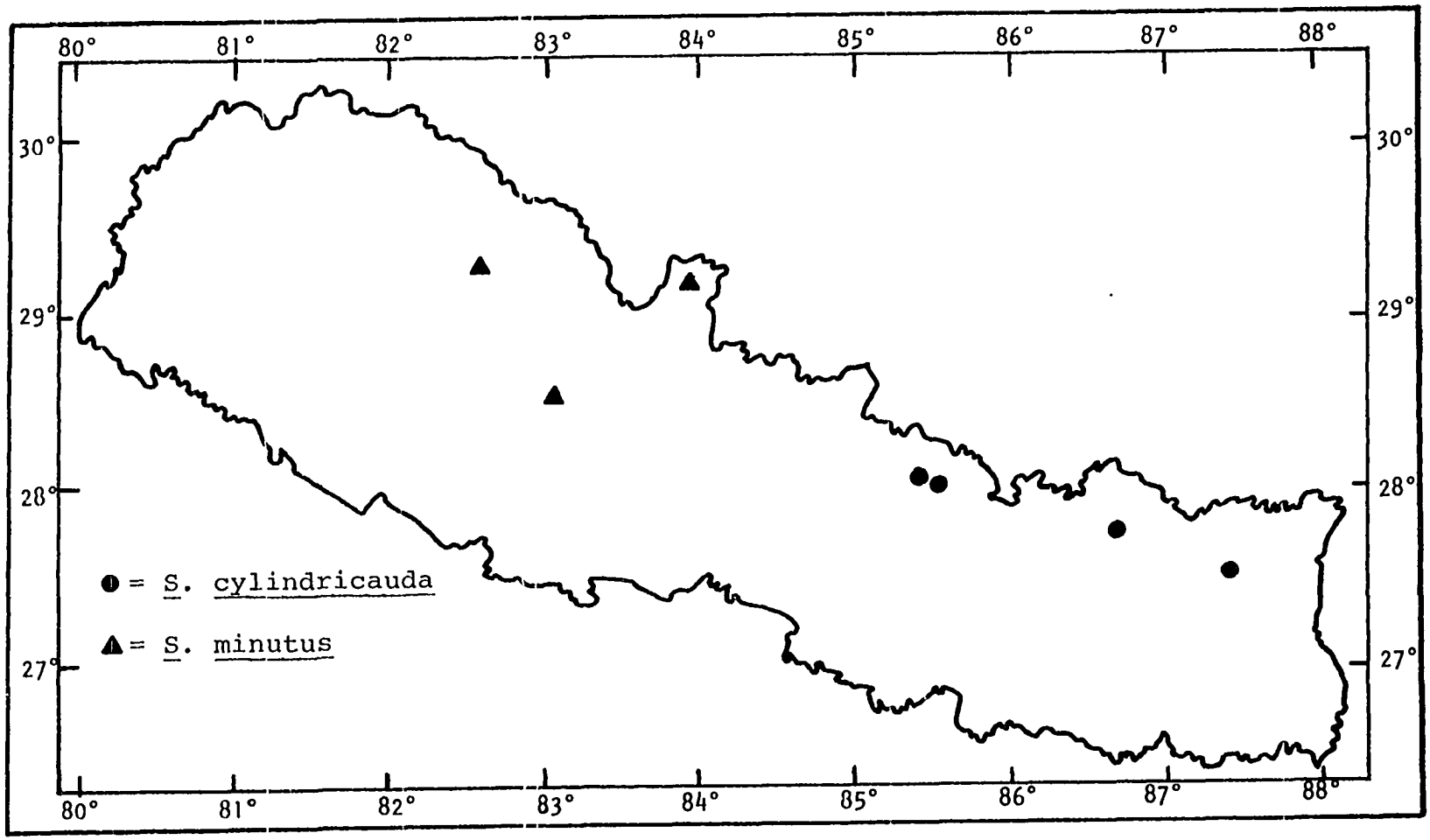


Fig. 15. Collection sites for Sorex sp.

Sorex cylindricauda cylindricauda Milne-Edwards, 1872

Lesser Shrew

1872. Sorex cylindricauda Milne-Edwards. Nouv. Arch. Mus. H.N., Paris Bull. 7: 92.

Type locality: Moupin, Western Szechuan, China.

1911. Sorex bedfordiae Thomas. Abst. Proc. Zool. Soc. 90: 3, 164.

Type locality: Omisan, Szechuan, China.

1911. Sorex wardi fumeolus Thomas. Abstr. Proc. Zool. Soc. 100, 49. 1912, 132.

Type locality: Weichoe, on Siho River, Western Szechuan, China.

1969. Sorex cylindricauda nepalensis Weigel. Khumbu Himal. Band 3, Lieferung 2, p. 152 (new syn.)

Type locality: Junbesi, East Nepal.

Distribution: Western Szechuan, Yunnan, Northern Burma and Nepal.

Nepal Records: Weigel (1969, p. 152).

NEP: 73 specimens: Mitchell - 69; AVWE - 4.

Habitat: Subalpine and alpine regions of the eastern and central midlands, from tree line to alpine meadows; 2700 to 3300 m.

Field Notes: The lesser shrew is small (TL: 118 to 138 mm) with a long, slender tail about the length of the head and body. The dorsal surface of the body is dull, cinnamon brown with an ill-defined dark stripe down the back. The tail is distinctly bicolored with a narrow dark stripe down the dorsal surface. The ventral pelage is dark gray.

Skull measurements for 10 Nepalese specimens are: (1) greatest length: 17.1 to 18.1 mm, (2) breadth of brain case: 8.4 to 8.9 mm and (3) interorbital constriction: 3.7 to 4.0 mm. In the subspecies S. c. nepalensis Weigel, the skull measurements of seven specimens are: (1) greatest length: 18.0 to 18.6 mm, (2) breadth of brain case: 8.2 to 8.6 mm and (3) interorbital constriction: 3.6 to 3.8 mm. Weigel (1969) stated that S. c. nepalensis, from eastern Nepal, is distinguished from a series of S. c. cylindricauda, collected in Szechuan, by its longer, broader skull, longer palate, longer molar row and larger lower jaw.

Little information was obtained on the breeding biology since most of the specimens were collected during October and November. Pre-monsoons appear to be the most active breeding season. A female taken in September contained five embryos.

Lesser shrews were common at high elevations in the central and eastern midlands with most of the specimens trapped above tree line. A few specimens were collected from dense rhododendron forests with the majority taken from alpine meadows and boulder heaps (3300 to 4300 m). Other insectivores taken in association with this species were Soriculus caudatus and S. nigrescens.

ECTOPARASITES

Siphonaptera:	Ctenophyllus triangularis
	Doratopsylla coreana
	Palaeopsylla helenae
	P. tauberi
	P. n. sp.
Ixodoidea:	Ixodes lindbergi (="ovatus")
Parasitoidea:	Androlaelaps soricinus
	Haemogamasus suncus
	Laelaps turkestanica
Anoplura:	Ancistroplax sp.

Soriculus nigrescens nigrescens (Gray, 1842)

Sikkim Large-clawed Shrew

1842. Corsira nigrescens Gray. Ann. Mag. Nat. Hist. 10: 261.

Type locality: Darjeeling, India.

1842. Sorex aterrimus Blyth. J. Asiat. Soc. Bengal 12: 928.

Type locality: Darjeeling, India.

1846. Sorex soccatus Hodgson, in Gray. Cat. Hodgson's Coll. B. M. p. 17 (1845. Ann. Mag. Nat. Hist. 15: 270).

Type locality: Nepal.

1849. Sorex sikimensis Hodgson, in Horsfield. Ann. Mag. Nat. Hist. 3: 203.

Type locality: Darjeeling.

1854. Soriculus nigrescens Blyth. J. Asiat. Soc. Bengal 23: 733.

Type locality: Darjeeling.

1863. Sorex oligurus Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 8. (nom. nud.)

Type locality: Sikkim.

1863. Sorex holosericeus Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 9. (nom. nud.)

Type locality: Darjeeling, India.

1922. Soriculus nigrescens centralis Hinton. J. Bombay Nat. Hist. Soc. 28: 1054. (new syn.)

Type locality: Bowzini, Nepal.

1922. Soriculus nigrescens pahari Hinton. J. Bombay Nat. Hist. Soc. 28: 1053. (new syn.)

Type locality: Gnatong, Sikkim.

1922. Soriculus nigrescens caurinus Hinton. J. Bombay Nat. Hist. Soc. 28: 1054. (new syn.)

Type locality: Kumaon, Northern India.

Distribution: Bhutan, Sikkim, Darjeeling, Nepal midlands and Kumaon.

Nepal Records: Gray (1846, p. 17), Horsfield (1849, p. 203), Hinton (1922a, p. 1054), Fry (1925, p. 526), Biswas and Khajuria (1957, p. 233), Worth and Shah (1969, p. 127), Weigel (1969, p. 150), Abe (1971, p. 388).

NEP: 245 specimens: Mitchell - 210; Maser - 6; AVWE - 29.

Habitat: Common throughout the midlands from east to west in three altitudinal zones: (1) humid zone of deciduous and coniferous forests, (2) temperate zone of conifer-rhododendron forests and (3) alpine zone above tree line.

Taxonomic notes: Many scientific names have been proposed for the Sikkim large-clawed shrew: Sorex aterrimus Blyth, 1842; Sorex soccatus Hodgson, 1845; Sorex sikimensis

Hodgson, 1849; Sorex oligurus Gray, 1863 and Sorex holosericeus Gray, 1863. Lacking descriptions, the above are nomina nuda.

Hinton (1922a) proposed three new subspecies: S. n. pahari, S. n. caurinus and S. n. centralis. He based his subspecies on differences in color and body size, stating, "S. n. pahari is distinguished from the typical form by its slightly larger size and by its lighter color. Soriculus nigrescens caurinus resembling the typical form in proportions, but color colder and grayer. S. n. centralis is distinguished from the typical form most readily by its darker color and different proportions." Since there is such a wide variation in size and color in specimens collected from Nepal, it would seem that characters used for Hinton's subspecies are in question. One therefore concludes that only one species and subspecies exists in Nepal.

Field Notes: The genus Soriculus is distinguished from Sorex by the relatively longer tail and by the reduction of the dental formula through the loss of one of the upper premolars. The dental formula is: i. 3/1; c. 1/1; pm. 2/1; m. 3/3 = 30. Members of this genus are referred to as the "brown-toothed" shrews because the teeth are tipped with reddish brown. This largely wears off in older animals.

Soriculus nigrescens is a rather heavily built, fossorial shrew with enlarged foreclaws and a short tail, which is

rarely as much as 70% of the head and body length. The color ranges from deep glossy brown to almost sooty black. The back is clove brown to sepia, the sides olive brown to brownish olive, and the belly olive brown to drab. The muzzle is thickly furred and the ears are small and completely hidden in the fur. The tail is short, gently tapered and thinly covered with short hair. The fur is soft, dense and velvety. Three pairs of mammae are present, one inguinal and two pubic.

Its diet consists primarily of insect larvae and adults, earthworms and snails. Abe (1971) reported that the bulk of the stomach contents from 44 specimens contained beetles, Diptera, Hymenoptera and other undetermined insects.

These shrews nest in stone fences, and the nest consists of a compact ball of dry grasses and fibrous material about 12 to 15 cm in diameter lined with fine grasses. Three nests were excavated from beneath stone piles.

There are two peak breeding periods, May and August. In May, 42% of the males possessed enlarged testes, 33% of the females were pregnant and 44% of the females bore uterine scars. Breeding information for the month of August is: 18% of the males had enlarged testes, 20% of the females bore embryos, 36% were lactating and 29% possessed uterine scars. Immatures and subadults made up 16% of the total catch. Any specimen having a total length of less than 110 mm was

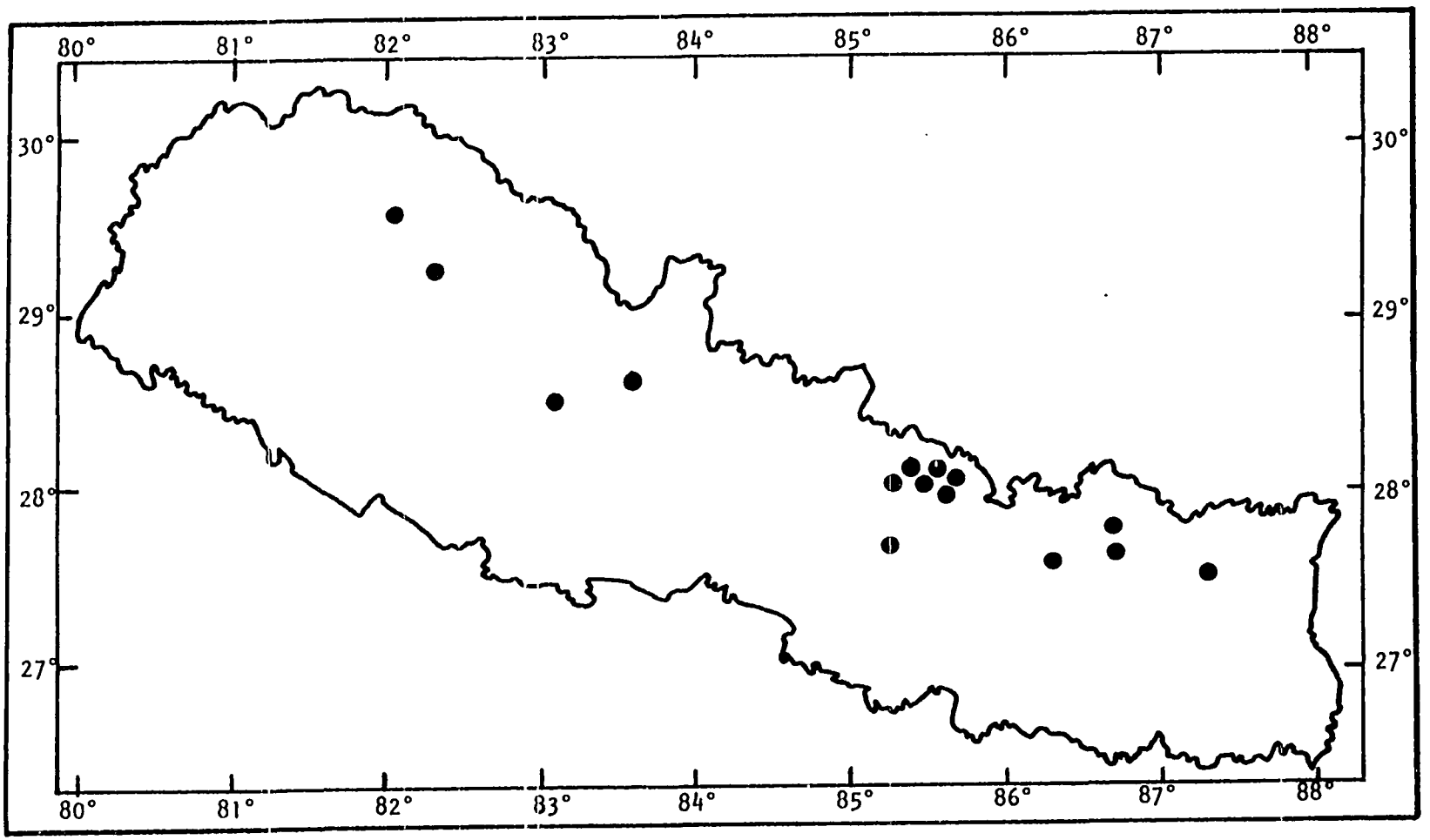


Fig. 16. Collection sites for Soriculus nigrescens

considered a juvenile. Two to three litters are produced annually and litter size ranges from three to seven with five the average. Females bearing embryos are listed in Table 2.

These shrews were collected near human habitation, around cultivated fields and along the forest edge. Blanford (1888) listed the altitudinal range of S. nigrescens in the Darjeeling District of India as 1210 to 1820 m. Hinton (1922a) reported collecting this shrew at 3730 m in Sikkim. All Nepalese specimens were collected between 2200 and 4200 m in the midlands. None were taken from the lowland Terai or the alpine desert biotope of the Tibetan Plateau. In only two instances did S. nigrescens coexist with Suncus murinus. It seems that S. murinus is a more aggressive lowland shrew with which S. nigrescens cannot compete. Soriculus caudatus, S. leucops, Suncus etruscus pygmaeoides, Crocidura attenuata and C. horsfieldi were also collected with S. nigrescens.

ECTOPARASITES

Siphonaptera:
Amphalius clarus
Citellophilus mygala
C. atallahi
Hystrichopsylla n. sp.
Neopsylla marleaneae
N. secura
N. n. sp.
Palaeopsylla helenae
P. remota remota
P. tauberi
P. #1 n. sp.
P. #2 n. sp.

Table 2. Female Soriculus nigrescens bearing embryos.

Collection number	Date collected	Number of embryos	Average length (in mm)
753	4 July 1968	4	6.7
979	15 August 1968	3	-
997	17 August 1968	4	-
1010	19 August 1968	5	12.0
1377	15 October 1968	4	-
2613	23 May 1969	7	4.9
2614	23 May 1969	5	11.8
2762	30 May 1969	6	-
2952	9 August 1969	6	4.3

	P. #3 n. sp.
	Paradoxopsyllus hollandi
	Smitipsylla maseri
	Stenischia pagiana
	S. n. sp.
	Xenodaeria telios
Ixodoidea:	Dermacentor auratus
	Haemaphysalis aponommoides
	Ixodes lindbergi (="ovatus")
	I. sp.
	I. sp. A
	I. sp. B
Parasitoidea:	Androlaelaps sp.
	A. soricinus
	A. triangularis
	Eucheyletia sinensis
	Eulaelaps indescretus
	E. stabularis
	Haemogamasus sp.
	H. nidiformis
	H. oliviformis
	H. suncus
	H. triangularis
	Histionyssus sp.
	H. latiscutatus
	Hypoaspis sp.
	H. sardoa
	Laelaps algericus
	Myonyssus tuberosus
	Prothrix sp.
	Ascidae
	Macrochelidae
	Pachylaelapidae
Uropodoidea:	Uropodina sp.
Anoplura:	Hoplopleura capitosa

Soriculus caudatus caudatus (Horsfield, 1851)

Hodgson's Brown-toothed Shrew

1849. Sorex caudatus Hodgson in Horsfield. Ann. Mag. Nat. Hist. 2(3): 203. (nom. nud.)

Type locality: Darjeeling, India.

1851. Sorex caudatus Horsfield. Cat. Mamm. Mus. E. India Co., p. 135.

Type locality: Darjeeling, India.

1863. Sorex homourus Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 8. (nom. nud.)

Type locality: Sikkim.

1877. Soriculus gracilicauda Anderson. J. Asiat. Soc. Bengal 46, 2: 282.

Type locality: Sikkim.

1888. Soriculus caudatus Blanford. The Fauna Brit. India, Mamm. p. 230.

1890. Soriculus minor Dobson. Monogr. Insectiv. 3, pl. XXIV, Figs. 2-2b.

Type locality: Manipur.

1969. Soriculus caudatus soluensis Gruber. Khumbu Himal. Band 3, Lieferung 2, p. 309. (new syn.)

Type locality: Ringmo, East Nepal.

Distribution: Manipur, Sikkim, Darjeeling, throughout the Nepal midlands.

Nepal Records: Fry (1925, p. 526), Weigel (1969, p. 150), Abe (1971, p. 385).

NEP: 293 specimens: Mitchell - 286; Maser - 7.

Habitat: The midlands between 2700 to 4200 m in sub-alpine and alpine biotopes; common along the edges of rhododendron forests, especially near cultivation.

Taxonomic Notes: According to Horsfield (1849), Hodgson reported a new shrew, Sorex caudatus, from the Himalayas

but did not provide a description of the species. Horsfield (1851) retained the same name and described the species. Hodgson (Gray 1863b) named another new shrew, Sorex homourus, from the area, but again failed to provide a description of the species.

Gruber (1969) listed a new subspecies of the brown-toothed shrew Soriculus caudatus soluensis, from eastern Nepal. According to Gruber, this subspecies differs from S. c. caudatus because of small body and skull measurements and differences in relative growth of two skull measurements (regression lines). He also stated that it has smaller body and skull measurements than S. c. caudatus. Eight adults of S. caudatus were selected from each of the following areas (east, central and west midlands) for comparison of body and skull measurements with those of S. c. soluensis (Table 3). There is little difference in overall measurements and one therefore concludes that S. c. soluensis is a synonym of S. c. caudatus.

Field Notes: Soriculus caudatus is a slender shrew with small foreclaws and a long tail which is usually 90 to 109% of the head and body. The body color varies from wood brown to sooty black. The tail is sparsely clothed with short hair. The mammary formula and position are the same as in S. nigrescens.

Earthworms, insects and other invertebrates make up

Table 3. Comparison of skin and skull measurements of *Soriculus caudatus* with those of *S. c. soluensis* (in mm).

	S. caudatus Midlands			*S. c. soluensis*
	East	Central	West	
Total length	114.6-120.5	114.8-123.6	105.5-113.8	100 -119
Tail	54.6- 55.8	58.6- 60.9	53.3- 54.8	49 - 58
Head and body	57.1- 64.9	56.2- 62.7	52.2- 59.0	51 - 61
% Tail/head and body length	85.6- 95.7%	91 -104%	92.8- 97.9%	95 - 96%
Greatest length skull	17.4- 19.2	17.5- 19.2	17.4- 18.0	
Condylobasal length	16.1- 17.0	16.8- 18.2	16.2- 17.0	16.6- 17.9
Breadth of braincase	8.5- 9.2	8.9- 10.0	8.6- 8.9	8.4- 9.4
Interorbital constriction	3.6- 3.9	3.8- 4.5	3.7- 3.9	
Upper tooth row	7.4- 7.8	7.3- 8.1	7.5- 7.9	7.6- 8.2

the diet. Beetle elytra were found in the stomach contents of several specimens. These shrews have been known to feed on small rodents and insectivores caught in traps.

There is a definite pre- and post-monsoon breeding season with April and May the peak period of breeding activity. One to two litters are produced each season. Based upon the number of uterine scars and embryos present, the litter size ranges from three to six with five the average. Females bearing embryos are listed in Table 4. In May nearly 38% of the adults trapped showed signs of having bred or being sexually mature: 13% of the males had enlarged testes; of the females, 29% bore embryos, 12% were lactating and 18% possessed uterine scars. Of the females collected in August, 20% were either pregnant or lactating, or bore uterine scars. By October only 3.5% of the females showed any physiological signs of reproduction.

Soriculus caudatus is widespread throughout the midlands and frequents dense oak-rhododendron forests, subalpine and alpine meadows. In the drier regions of the west midlands, this shrew is replaced by Crocidura horsfieldi. In the Terai and duns, Suncus murinus is the predominant insectivore. No brown-toothed shrews were collected below 2200 m.

This species was frequently trapped near human habitation and around cultivated fields. It occurs sympatrically with S. nigrescens, but only two syntopic occurrences have been

Table 4. Female Soriculus caudatus bearing embryos.

Collection Number	Date Collected	Number of Embryos	Average length (in mm)
1098	30 August 1968	3	7.7
1106	31 August 1968	5	4.5
2473	6 May 1969	6	8.6
2492	9 May 1969	5	7.4
2499	9 May 1969	5	3.6
2516	10 May 1969	5	8.4
2530	11 May 1969	5	5.5
2966	10 August 1969	4	12.1

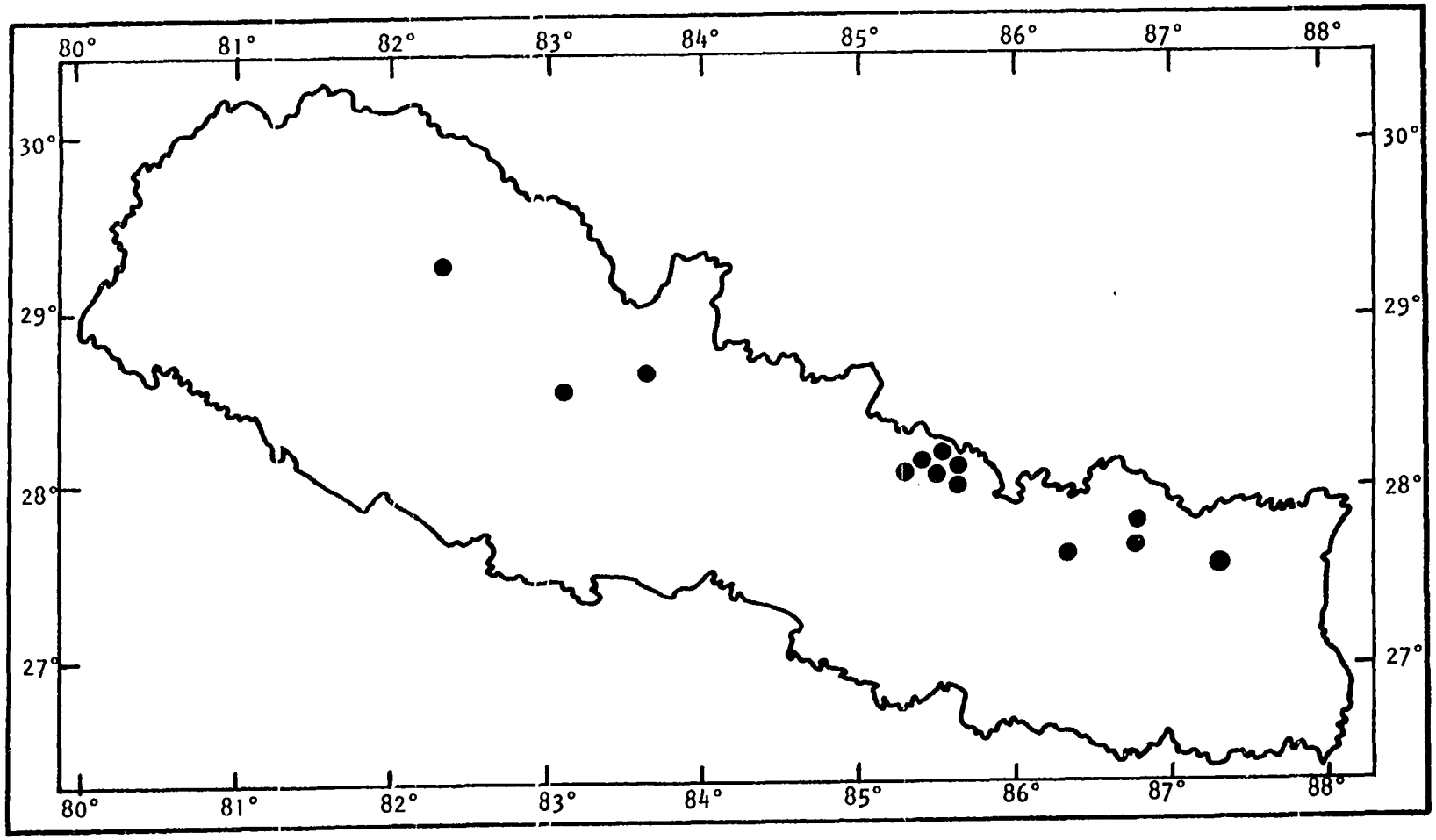


Fig. 17. Collection sites for Soriculus caudatus

recorded with Suncus murinus (Tarke Ghyang and Melumche). The largest number of specimens were trapped before and after monsoons.

ECTOPARASITES

Siphonaptera:	Hystrichopsylla n. sp.
	Neopsylla secura
	Palaeopsylla helenae
	P. remota
	P. tauberi
	Paradoxopsyllus digitatus
	Stenischia n. sp.
	Xenodaeria telios
Ixodoidea:	Haemaphysalis aponommoides
	H. nepalensis
	Ixodes lindbergi (="ovatus")
	Ixodes sp.
	I. sp. A
	I. sp. B
Parasitoidea:	Androlaelaps soricinus
	Haemogamasus sp.
	H. nidiformis
	H. oliviformis
	H. suncus
	Histionyssus latiscutatus
	Laelaps algericus
	L. turkestanica
Anoplura:	Ancistroplax crocidurae

Soriculus gruberi Weigel, 1969

Gruber's Shrew

1969. Soriculus gruberi Weigel. Khumbu Himal. Band 3, Lieferung 2, p. 170.

Type locality: Junbesi, Nepal.

Distribution: The Solukhumbu region of northeast Nepal.

Nepal Records: Weigel (1969, p. 153).

Habitat: The humid zone of deciduous, coniferous and conifer-rhododendron forests of eastern Nepal, from 2500 to 3700 m.

Discussion: In 1969 seven specimens of a new shrew, Soriculus gruberi, were collected from solukhumbu District, northeast Nepal. Weigel (1969) described S. gruberi as a middle sized, slate gray shrew with a brownish hue. He followed the color standards set forth in Ridgway (1912): the back is chaetura drab (plate XLVI) with the belly mouse gray (plate LI) to gray (plate XLVI). The tail is usually longer than the head and body. Gruber's shrew differs from S. nigrescens in color, size and tail length. The body measurements are larger, the skull is longer and wider and the color differs from S. caudatus. The third incisor is as large as or larger than the second and the canine is somewhat smaller than the third incisor.

According to Gruber (1969), this shrew prefers moist biotopes and is only found in the zone of conifer-rhododendron forests. Particulars concerning the ecology and breeding biology were not included.

Soriculus leucops (Horsfield, 1855)

Indian Long-tailed Shrew

1855. *Sorex leucops* Horsfield. Ann. Mag. Nat. Hist. 16: 111.

Type locality: Nepal.

1863. *Sorex nivicola* Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 8. (*nom. nud.*)

1863. *Sorex macrurus* Hodgson, *in* Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 9. (*nom. nud.*)

1888. *Soriculus macrurus* Blanford. The Fauna Brit. India, Mamm. p. 231.

Type locality: Darjeeling, Northern India.

1911. *Soriculus irene* Thomas. Abstr. Proc. Zool. Soc. 49. 1912, 132.

Type locality: Yuanchinghsien, southwestern Szechuan.

Distribution: Nepal, Darjeeling, West Bengal, Sikkim and Szechuan, China.

Nepal Records: Gray (1863b, p. 8), Weigel (1969, p. 150), Abe (1971, p. 387).

NEP: 5 specimens: Mitchell - 5.

Habitat: Moist biotopes near flowing water in the oak-rhododendron forests of the central and eastern midlands, from 2000 to 3000 m.

Field Notes: *Soriculus leucops* is a slender shrew with a tail about 150% of the head and body length. The pelage is a pale, silvery gray above and the sides are a little paler with the belly clear, pale gray. The feet are whitish with

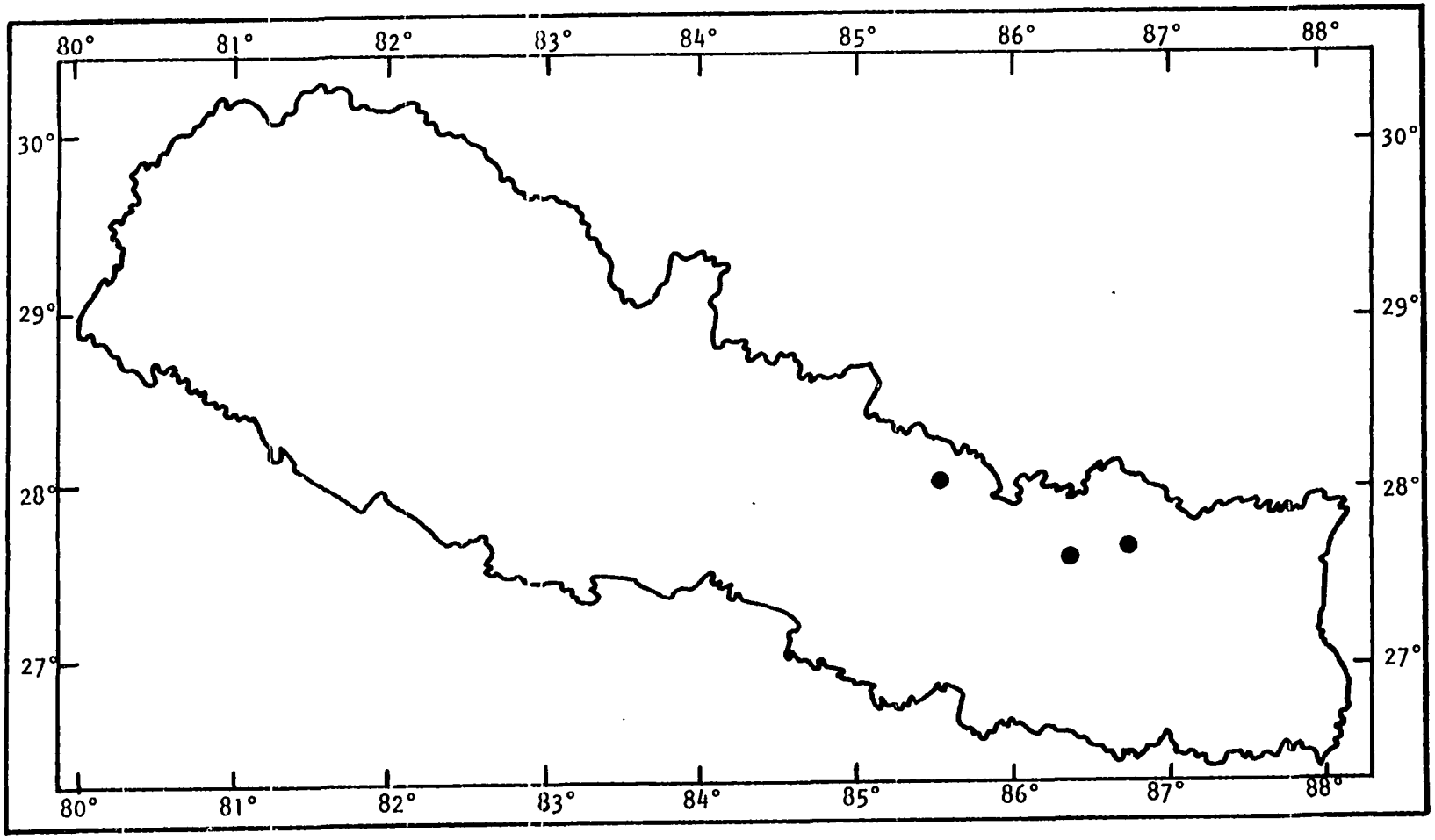


Fig. 18. Collection sites for Soriculus leucops

pale brown markings on the central metatarsal area. The tail is long, thin and sparsely clad with short hairs. The ears are partially concealed by the fur, which is long and soft.

The skull resembles that of Sorex, but is less slender. The rostrum is not as narrow and tapered. There are nine upper teeth per side and the last unicuspid is exceedingly reduced. The tips of the tooth cusps are dark chestnut.

Little has been reported on the biology of this species and few collection records exist. Since so few specimens were taken by our field team, information concerning the breeding biology was not obtained. This species was collected with S. caudatus and S. nigrescens.

ECTOPARASITES

Siphonaptera:	Palaeopsylla tauberi Xenodaeria telios
Ixodoidea:	Ixodes lindbergi (="ovatus")

Suncus murinus murinus(Linnaeus, 1766)

House Shrew

1766. Sorex murinus Linnaeus. Syst. Nat. 12th ed. Vol. 1, p. 74.

Type locality: Java.

1785. Sorex myosurus Pallas. Acta Acad. Sci. Petrop. 1781, 2: 337. (Substitute for murinus Linnaeus).

1792. Sorex caerulaeus Kerr. Anim. King. 207.

Type locality: Java.

1811. Sorex indicus Geoffroy. Ann. Mus. H. N. Paris 17: 183.

Type locality: Pondicherry, India.

1827. Sorex sonneratii Geoffroy. Mém. Mus. H. N. Paris 15: 132.

Type locality: India.

1831. Sorex serpentarius Geoffroy, in Belanger. Voy. Indes Orient. Zool. 119.

Type locality: Pondicherry, India.

1845. Sorex murinus Hodgson. Ann. Mag. Nat. Hist. 15: 269

Type locality: Central region of Nepal.

1845. Sorex nemorivagus Hodgson. Ann. Mag. Nat. Hist. 15: 269.

Type locality: Central region of Nepal.

1855. Sorex saturatior Hodgson, in Horsfield. Ann. Mag. Nat. Hist. 16: 110.

Type locality: Darjeeling.

1859. Sorex swinhoei Blyth. J. Asiat. Soc. Bengal 28: 285.

Type locality: Amoy, southern China.

1860. Sorex albinus Blyth. J. Asiat. Soc. Bengal 29: 90. (nom. nud.)

1870. Crocidura microtis Peters. Mber. Preuss. Akad. Wiss. 589.

Type locality: Hong Kong, China.

1870. Crocidura (Pachyura) waldemarii Peters. Mber. Preuss. Akad. Wiss. 590.

Type locality: Bengal.

1870. Crocidura (Pachyura) media Peters. Mber. Preuss. Akad. Wiss. 592.

Type locality: Paradenia, Ceylon.

1877. Crocidura (Pachyura) pealana Anderson. J. Asiat. Soc. Bengal 46: 267.

Type locality: Sibsagar, Assam.

1877. Crocidura (Pachyura) rubicunda Anderson. J. Asiat. Soc. Bengal 46: 277.

Type locality: Hazaribagh, Bihar, India.

1879. Crocidura andersoni Trouessart. Rev. Zool., Paris. 253.

Type locality: Khasi Hills, Assam.

1881. Sorex beddomei Anderson. Cat. Mamm. Ind. Mus. 179.

Type locality: Kollegal Hills, Coimbatore District, Southern India.

1888. Crocidura murina Blanford. The Fauna Brit. India, Mamm. p. 233.

1906. Crocidura (Pachyura) murina Allen. Bull. Amer. Mus. Nat. Hist. 22: 481.

Type locality: Hainan, China.

1915. Crocidura muschata Hatori. Taiwan Igakukae Zasshi, Jan. Number (N.V.)

Type locality: Formosa.

1929. Suncus myosurus Howell. Proc. U.S. Nat. Hist. Mus. 75 (11) : 9.

Type locality: Fukien, China.

1929. Suncus caeruleus Lindsay. J. Bombay Nat. Hist. Soc. 33: 327.

Type locality: Jumna and Ganges Plains.

Suncus murinus caerulescens (Shaw, 1800)

1796. Sorex pilorides Shaw. Mus. Lever 2: 31.

1800. Sorex caerulescens Shaw. Gen. Zool., Mamm. 1: 533.

Type locality: Bengal, India.

1831. Sorex giganteus Geoffroy. Voy. Belanger Indes Orient. Zool. 117.

Type locality: Bengal.

1881. Crocidura caerulescens Anderson. Cat. of Mamm. in the Ind. Mus., Calcutta. p. 171.

1888. Crocidura caerulea Blanford. The Fauna Brit. India, Mamm. p. 236.

1929. Suncus caeruleus caeruleus Lindsay. J. Bombay Nat. Hist. Soc. 33: 329.

Type locality: Chanda, Central Provinces, India.

1929. Suncus caeruleus giganteus Lindsay. J. Bombay Nat. Hist. Soc. 33: 329.

Type locality: East Nepal.

Suncus murinus soccatus (Hodgson, 1845)

1845. Sorex soccatus Hodgson. Ann. Mag. Nat. Hist. 15: 270.

Type locality: Central region of Nepal.

1855. Sorex heterodon Blyth. J. Asiat. Soc. Bengal 24: 31.

Type locality: Cherrapunji, in Khasi Hills, Assam.

Suncus murinus tytleri (Blyth, 1859)

1859. Sorex tytleri Blyth. J. Asiat. Soc. Bengal 28: 285.

Type locality: Dehra Dun, northern India.

1929. Suncus caeruleus tytleri Lindsay. J. Bombay Nat. Hist. Soc. 33: 331.

Type locality: Kangra, Punjab, northern India.

Distribution: Southeastern China, Burma, Assam, Sikkim, West Bengal, Bihar, Nepal, Kumaon, Punjab, Kashmir, Afghanistan westward to Arabia.

Nepal Records: Hodgson (1845, pp. 269-270), Hinton and Fry (1923, p. 409), Fry (1925, p. 526), Lindsay (1929a, pp. 329-331), Worth and Shah (1969, p. 127), Weigel (1969, p. 150), Chesemore (1970, p. 163), Abe (1971, p. 392).

NEP: 70 specimens: Mitchell - 44; Maser - 26.

Habitat: From five of the seven major life zones: Terai, Siwaliks, Mahabharat Lekh, duns and midlands (90 to 2400 m).

Taxonomic Notes: The white-toothed shrews, belonging to the genus Suncus, all have 30 teeth; the dental formula is: i. 3/1; c. 1/1; pm. 2/1; m. 3/3 = 30. The dental formula differs from Crocidura by an extra upper unicuspid tooth. Sorex has 32 teeth compared to 30 for Suncus. The teeth are white and unpigmented compared to the chestnut-tipped teeth in the Soricinae. The first upper incisor is large and hook-like.

Systematists have changed the generic name several times: Sorex, Crocidura and Pachyura have all been proposed

as generic names, but Suncus antedates Pachyura (Cabrera 1924). The oldest application of Sorex is to the European brown-toothed shrew (Sorex araneus L., 1758) and of Crocidura to shrews with 16 upper teeth instead of 18. Thus, Suncus remains the valid generic name (Lindsay 1929a).

Field Notes: Three subspecies of Suncus murinus are recognized for Nepal: S. m. caerulescens from the eastern Terai and the Kathmandu Valley, S. m. soccatus from the central and eastern midlands and S. m. tytleri from the western Terai and the Mahabharat Lekh. The validity of these subspecies is based upon habitat preference and cranial and morphological differences (Lindsay 1929a; Ellerman and Morrison-Scott 1966). For differences in body and cranial measurements and collection sites, see Table 5 and Fig. 19.

Suncus murinus caerulescens, the largest shrew of the group, is the common house shrew of the plains (TL: up to 245 mm). It is called the "musk" shrew because of the presence of large anal and costal glands which emit a strong, musky odor. The overall color is a uniform slate blue with the nude parts flesh white. The muzzle, ears and extremities are partially bare and the tail is covered with scattered and divergent bristles. Three pairs of mammae are present, one inguinal and two pubic.

These nocturnal shrews were commonly collected from livestock compounds, houses and grist mills in the eastern

Table 5. Comparison of skin and skull measurements of Suncus murinus ssp. (in mm).

	caerulescens (16)	soccatus (18)	tytleri (10)
Total length	186.6 - 243.8	176.0 - 193.1	181.4 - 195.0
Head and body	124.8 - 148.9	108.8 - 123.2	111.7 - 119.1
Tail	61.8 - 94.9	67.2 - 69.9	69.7 - 75.9
% Tail/head and body	48.9 - 63.6%	56.9 - 60.2%	62.3 - 63.7%
Hindfoot	19.9 - 25.3	19.8 - 21.0	17.1 - 19.2
Ear	12.3 - 13.7	10.9 - 12.4	12.5 - 14.6
Greatest length of skull	31.3 - 32.3	29.5 - 30.8	27.9 - 29.8
Condylobasal length	29.2 - 30.4	28.7 - 29.4	26.4 - 28.6
Breadth of braincase	13.0 - 14.1	12.2 - 13.0	12.4 - 12.7
Interorbital constriction	4.9 - 6.1	5.5 - 5.9	5.1 - 5.3
Upper tooth row	11.6 - 11.8	10.9 - 11.3	10.8 - 11.0
Lower tooth row	9.6 - 9.8	9.0 - 9.3	8.7 - 8.8
Mandible	19.9 - 20.3	18.6 - 19.6	17.8 - 18.7

Terai, the Rapti Dun and the Kathmandu Valley. Abe (1971) found that insects comprise the bulk of the diet. Earthworms, spiders and gastropods are also important food items.

Suncus murinus soccatus, a smaller variety (TL: 175-195 mm), inhabits the central and eastern midlands. The dorsal pelage is uniform brown or a brownish slate blue with the lower parts paler and grayish. The fur of the ears, feet and tail is brown and the skin dusky, not flesh-colored as in caerulescens. The mammary formula is the same as in caerulescens.

S. m. soccatus is distinguished from caerulescens by a smaller size, the feet being clad in fur to the nails, a thicker, more tapering tail and by a more depressed head. The condylobasal length is shorter and the interorbital constriction narrower with a shorter lower mandible and shorter upper and lower tooth rows (Figs. 20b, 21b and 22b).

This subspecies is strictly a midlands variety that does not overlap in range with S. m. caerulescens. Specimens were collected from the central and east midlands (1800 to 2500 m) from livestock sheds and stone fences surrounding fields of wheat and millet. These shrews were attracted to livetraps baited with dried fish. The diet consists of insects, worms and probably smaller mammals or birds.

The third subspecies, S. m. tytleri, resembles S. m. soccatus but has a longer tapering snout. Dorsally the color

is a light, sandy brown with a dusky hue and the belly is slate gray. There is a rufescent throat patch that extends between the forelegs. The tail, feet and ears are a shade lighter than the skin. The mammary formula is the same as above.

The skull is short and narrow with a very narrow interorbital constriction (5.1 to 5.3 mm). The upper and lower tooth rows and the lower mandible are shorter in proportion (Figs. 20c, 21c and 22c) than those of the other two subspecies.

This subspecies was collected from more arid biotopes of the western Terai, Mahabharat Lekh and Dang Valley between 200 and 1800 m. Specimens were trapped from local huts and stone fences bordering rice and wheat fields. The diet is similar to that of soccatus.

The breeding biology data have been treated collectively for the above three subspecies. Suncus murinus ssp. breed continuously from April through September. In April, 50% of the females examined bore embryos while another 33% were lactating. In June, 50% of the females were pregnant. Females bearing embryos were also taken in July and September. Litter size ranges from one to eight with four being the average (Table 6).

Table 6. Female *Suncus murinus* bearing embryos.

Collection number	Date collected	Number of embryos	Average length (in mm)
548	23 April 1968	6	12.6
567	25 April 1968	2	5.5
577	26 April 1968	1	5.4
682	27 April 1968	4	16.8
705	30 June 1968	2	-
750	4 July 1968	8	1.8
3114	10 September 1969	4	6.7

ECTOPARASITES

Siphonaptera:
Acropsylla episema
Nosopsyllus punjabensis
N. simla
Lentistivalius ferinis
Xenodaeria telios

Ixodoidea:
Haemaphysalis montgomeryi
Ixodes lindbergi (="*ovatus*")
I. redikorzevi group

Parasitoidea:
Allodermanyssus sanguineus
Gahrliepia (*Schoengastiella*) sp.
Haemolaelaps triangularis
Histionyssus sp.
Laelaps algericus
L. myonyssognathus
L. nuttalli
Polylaelapidae

Mallophaga:
Degeeriella regalis

Anoplura:
Polyplax reclinata

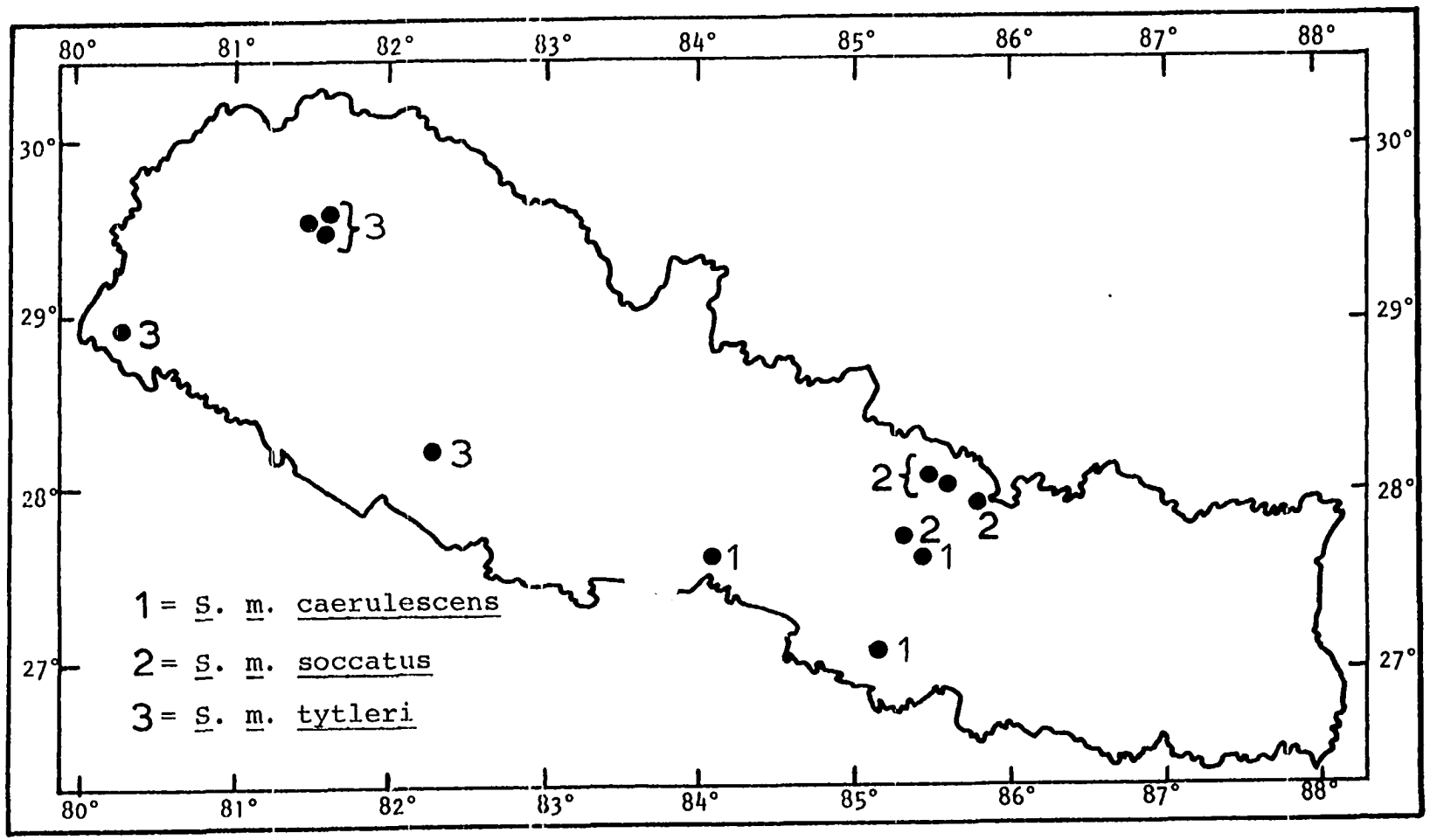


Fig. 19. Collection sites for Suncus murinus ssp.

Fig. 20. Suncus murinus ssp. skulls (dorsal view-1.8x)

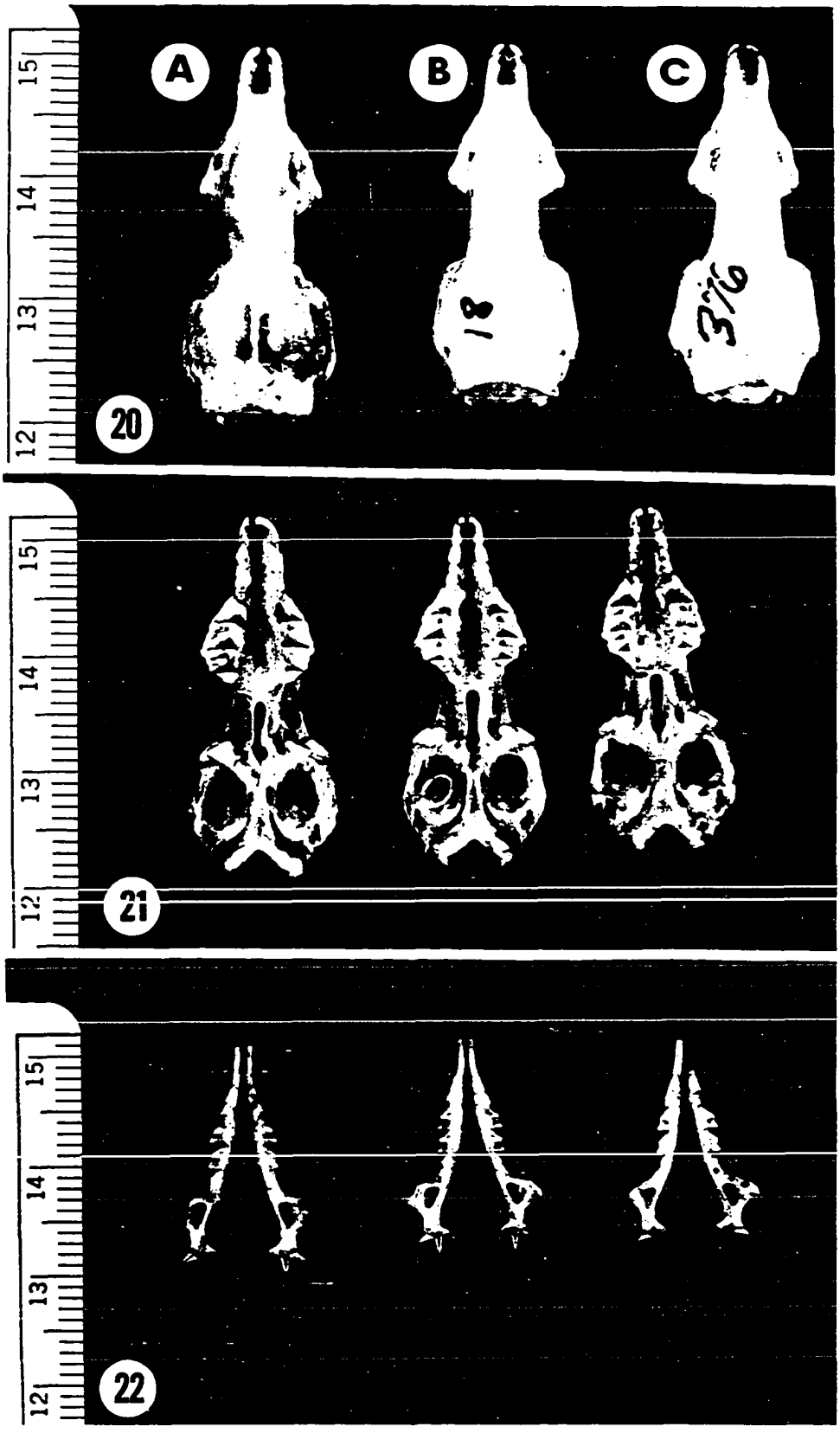
A. Suncus murinus caerulescens
B. S. m. soccatus
C. S. m. tytleri

Fig. 21. Suncus murinus ssp. skulls (ventral view-1.8x)

A. Suncus murinus caerulescens
B. S. m. soccatus
C. S. m. tytleri

Fig. 22. Suncus murinus ssp. skulls (lower mandibles-1.8x)

A. Suncus murinus caerulescens
B. S. m. soccatus
C. S. m. tytleri


A
B
C
18
3/16
20
21
22
12
13
14
15

Suncus etruscus pygmaeoides (Anderson, 1877)

Himalayan Pygmy Shrew

1845. Sorex pygmaeus Hodgson. Ann. Mag. Nat. Hist. 15: 269.

Type locality: Central Hills, Nepal.

1855. Sorex micronyx Blyth. J. Asiat. Soc. Bengal 24: 33.

Type locality: Kumaon.

1867. Sorex hodgsoni Jerdon. The Mamm. of India. p. 57.

Type locality: Darjeeling District.

1877. Crocidura (Pachyura) pygmaeoides Anderson. J. Asiat. Soc. Bengal 46: 279.

Type locality: Himalayas.

1888. Crocidura hodgsoni Blanford. The Fauna Brit. India, Mamm. p. 240.

1925. Pachyura perrotteti (Duvernay), in Fry. J. Bombay Nat. Hist. Soc. 30(2): 527.

Type locality: Knaping, Nepal.

Distribution: The Himalayas, Sikkim, Darjeeling, Nepal, Kumaon.

Nepal Records: Hodgson (1845, p. 269), Fry (1925, p. 527), Abe (1971, p. 392).

NEP: 10 specimens: Mitchell - 10.

Habitat: Near human settlements bordering oak-rhododendron forests in the central midlands, 220 to 2600 m.

Taxonomic Notes: The names pygmaeus, micronyx and hodgsoni were misapplied to Suncus etruscus instead of to S. perrotteti, to which the description applied. Since all the

above names are invalid, the next oldest name, Crocidura (Pachyura) pygmaeoides (Anderson, 1877), must stand (Lindsay 1929a). Ellerman and Morrison-Scott (1966) placed pygmaeoides in the genus Suncus, even though they felt that Suncus is little more than a subgenus of Crocidura.

Fry (1925) misidentified the pygmy shrew as Pachyura perrotteti instead of S. etruscus pygmaeoides. Pachyura has been used for a genus of white-toothed shrews. De Selys-Longchamps proposed Pachyura in 1839, but Suncus was established in 1832 by Hemprich and Ehrenberg (Cabrera 1924). Since Pachyura is antedated by Suncus, the valid generic name is Suncus.

Field Notes: The Himalayan pygmy shrew is very tiny, averaging 48 mm or less in head and body length. The dorsal parts vary in color from light sandy to dark brown. The lower parts are paler with gray on the throat. The long, slender tail, about three quarters the length of the head and body, is thinly clothed with short hair among which short bristles are scattered. The snout is long, narrow and pointed. The ears are large (5.8 to 6.2 mm) and thinly clad and the feet are partially bare. The mammary formula is the same as in Suncus murinus.

Hodgson (1845) reported that no odorous glands were detected in this species, but according to Blanford (1888), lateral glands develop during the mating season. Of the ten

specimens examined, lateral glands were not detected and none of these shrews possessed the musky odor which is so characteristic of S. murinus.

Little is known about the biology of this species. The food habits and breeding biology are probably similar to those of the other insectivores of the midlands. The only breeding information obtained was from the collection of two lactating females during August.

Due to the small size, this species easily escapes notice. A total of ten specimens was trapped from the central midlands. They were collected with Soriculus caudatus, S. leucops, S. nigrescens and Suncus murinus.

ECTOPARASITES

Parasitoidea: Androlaelaps soricinus
Laelaps algericus

Anoplura: Hoplopleura capitosa

Suncus stoliczkanus (Anderson, 1877)

Anderson's Shrew

1877. Crocidura (Pachyura) stoliczkana Anderson. J. Asiat. Soc. Bengal 46: 270.

Type locality: Bombay, India.

1877. Crocidura (Pachyura) bidiana Anderson. J. Asiat. Soc. Bengal 46: 276.

Type locality: Madras, India.

1888. Crocidura bidiana Blanford. The Fauna Brit. India, Mamm. p. 238.

Type locality: Bombay, India.

Distribution: Madras, Bombay, Rajputana, Central provinces, Nepal Terai.

NEP: 2 specimens: Mitchell - 2.

Habitat: The ecotone of farmland-jungle of the western Terai; 100 to 300 m.

Discussion: This medium-sized shrew resembles an immature S. murinus, but the tail is not swollen at the base. The color is light wood brown above with a mouse gray venter; the ears and feet are light tan and the tail is brown. The tail is short, averaging less than 55% of the head and body. Lindsay (1929a) reported a range of 70 to 73 mm in head and body length for the species. The head and body length was 73 and 78 mm for two Nepalese specimens. The mammary formula and position are the same as for other members of the genus.

Little information is present in the literature on the biology of this species. Both specimens were collected from Bahwanipur, Banke District, the first collection record for Nepal, thus extending the known range to 28° N. latitude (formerly 24° N. latitude).

ECTOPARASITES

None.

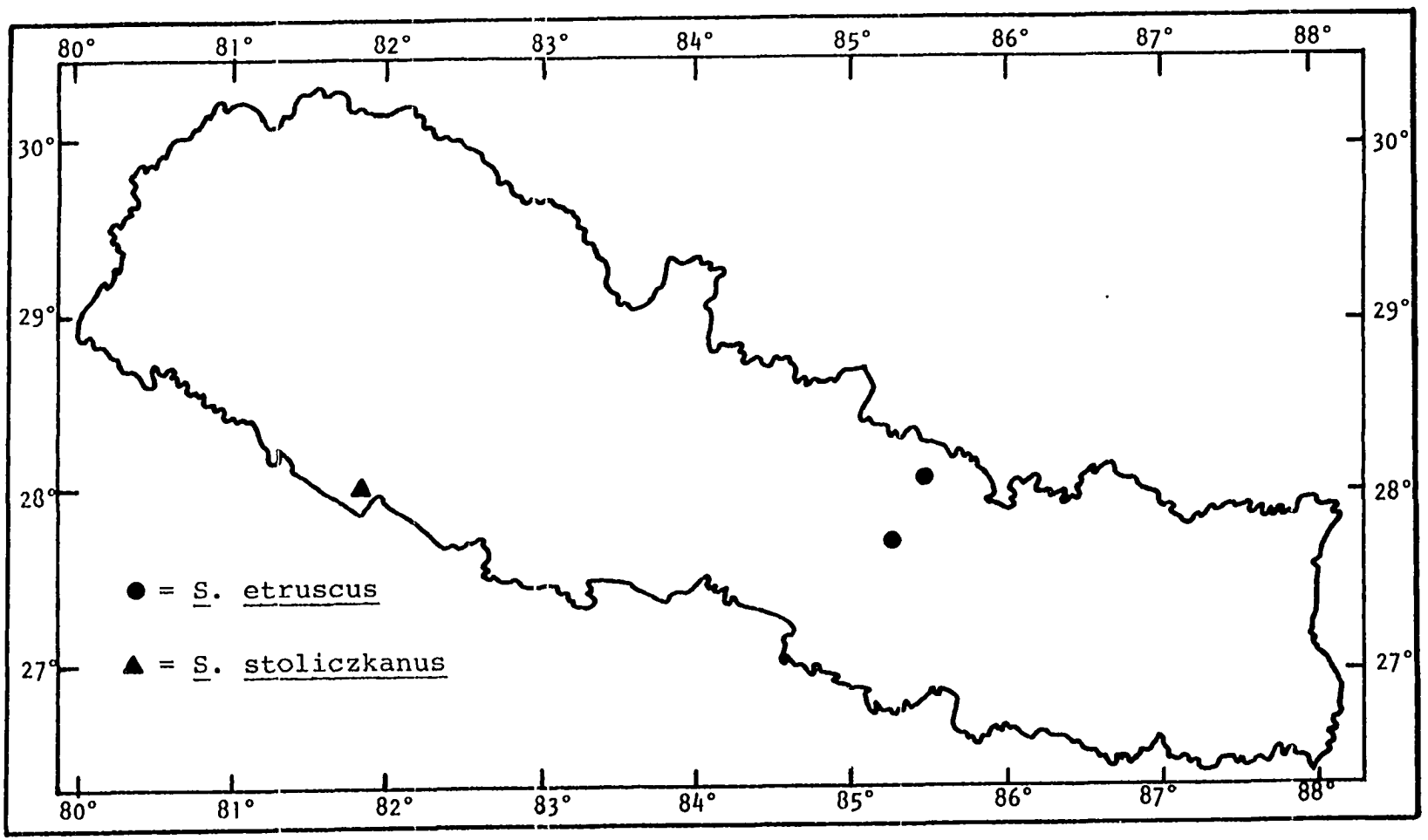


Fig. 23. Collection sites for other Suncus sp.

Crocidura horsfieldi horsfieldi (Tomes, 1856)

Horsfield's Shrew

1856. Sorex horsfieldi Tomes. Ann. Mag. Nat. Hist. 17: 23.

Type locality: Ceylon.

1870. Crocidura retusa Peters. Mber. Preuss. Akad. Wiss. p. 585.

Type locality: Paradenia, Ceylon.

1888. Crocidura horsfieldi Blanford. The Fauna Brit. India, Mamm. p. 242.

Distribution: Ceylon to Kashmir, probably Kumaon, western Nepal.

NEP: 13 specimens: Mitchell - 13.

Habitat: The western midlands between 2300 and 2900 m, from stone fences surrounding wheat fields.

Field Notes: Externally, this genus is similar to Suncus with a long snout and a tapering tail with scattered bristly hairs along its entire length. Crocidura is chiefly distinguished from Suncus by the loss of the fourth upper unicuspid. The dental formula is: i. 3/1; c. 1/1; pm. 1/1; m. 3/3 = 28 and the teeth are white and never pigmented.

This small shrew (TL. 105 to 117 mm) is bright ferruginous brown above and light gray below. The feet and tail are flesh colored. The ears are moderate in size and naked. Lateral glands are present in both sexes. Three pairs of mammae are present, one inguinal and two pubic.

Little is known about the habits of this shrew. Three females examined during April were carrying embryos. Two females taken on 2 April bore four and three embryos respectively; a third collected 9 April held three embryos.

Thirteen specimens were collected from the Jumla and Mugu Districts of the western midlands. This proved to be another new collection record for Nepal; the closest previous collection site had been Kashmir. These shrews occupy the drier biotopes of the west midlands and are replaced by Soriculus caudatus in the moister central and eastern midlands. The only insectivore coexisting with Crocidura horsfieldi was Soriculus nigrescens.

ECTOPARASITES

Siphonaptera:	Paradoxopsyllus acanthus
	Xenodaeria telios
Ixodoidea:	Haemaphysalis montgomeryi
	Ixodes himalayensis

Crocidura attenuata rubricosa Anderson, 1877

Gray Shrew

1877. Crocidura rubricosa Anderson. J. Asiat. Soc. Bengal 46, 2: 280.

Type locality: Sibsagar, Assam.

1888. Crocidura fuliginosa Blanford. The Fauna Brit. India, Mamm. p. 242.

Distribution: Assam, Bhutan Duars, Sikkim, Darjeeling and Nepal.

NEP: 3 specimens: Mitchell- 3 (two were collected from the Darjeeling District of India).

Habitat: The deep oak-laurel forests of the central and eastern midlands, from 2100 to 2750 m.

Field Notes: The gray shrew is similar in color to Suncus murinus soccatus, uniform brownish gray above and paler gray below. The tail and the upper surface of the feet are dark brown. In external characters, this shrew resembles Soriculus leucops. The main difference is the length of the tail. In S. leucops, the tail is 130% or more of the head and body length, while in C. attenuata the tail is 70% or more. The mammary formula is the same as for C. horsfieldi.

Little information was obtained concerning the general biology, distribution and habitat preferences of the species. According to Allen (1938), this shrew is common over the whole of southern China at lower elevations. He found that the young are born early in the year and that there is usually more than one litter annually.

A single specimen was trapped near Kakani, Nuwakot District. This is the first collection record from Nepal of the gray shrew. Two additional specimens were collected from the Darjeeling District of India. All these shrews were taken from moist biotopes. The species appears to be confined

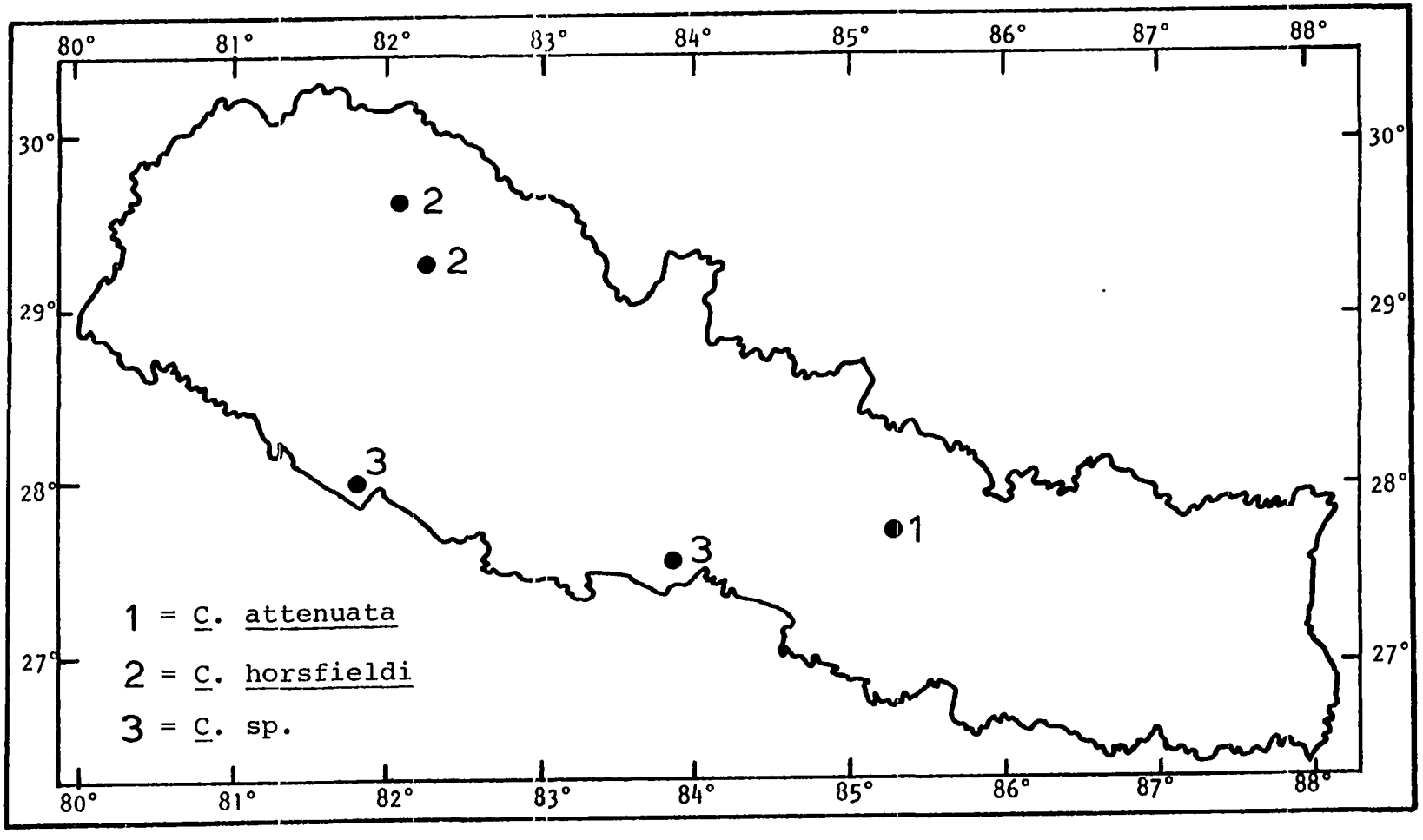


Fig. 24. Collection sites for Crocidura sp.

mainly to the humid temperate forests of the eastern Himalayas. Blanford (1888) reported that it was common at lower elevations (1500 to 2000 m) in Sikkim.

ECTOPARASITES

None.

Crocidura sp.

Distribution: The Rapti Dun and the western Terai of Nepal.

NEP: 3 specimens: Mitchell- 3.

Habitat: Along the edge of farmland-jungle; from 90 to 150 m.

Field Notes: Three specimens of a shrew that may be new to science were collected from the Rapti Dun and Bahwanipur, western Terai. This shrew resembles *Crocidura horsfieldi* in external appearance, but differs in body and cranial measurements and habitat preference. The color is ferruginous brown above, with light reddish gray on the flanks; the basal portion of the fur is light gray. The feet and tail are flesh-colored and elongated bristles are present on the tail.

Skin and skull measurements of these three specimens were compared with those of 13 specimens of *C. horsfieldi* (Table 7). Their measurements were also compared with those

of C. pergrisea. In C. sp., the condylobasal length measures 18.4 to 18.8 mm and the tail is 78 to 90% of the head and body length, while in C. pergrisea, the condylobasal length is 18.0 to 19.4 mm and the tail averages 80% of the head and body length.

Crocidura sp. was collected at low elevations (90 to 150 m) from disturbed areas of the jungles in the Rapti Dun and western Terai. In contrast, C. pergrisea occurs at high elevations (2880 m).

ECTOPARASITES

Parasitoidea: Haemolaelaps sp.
Haemolaelaps fenilis

Table 7. Comparisons of skin and skull measurements of Crocidura sp. with those of C. horsfieldi (in mm).

	Crocidura sp.	Crocidura horsfieldi
Total length	116.7 - 123.6	105.4 - 117.9
Tail	54.0 - 54.1	44.1 - 50.3
Head and Body	62.6 - 69.6	61.3 - 67.6
Tail length: head/body	77.6 - 91.3%	68.5 - 74.4%
Hind foot	12.8 - 13.7	11.8 - 13.1
Ear	7.9 - 8.1	7.3 - 8.0
Condylobasal length	18.4 - 18.8	16.7 - 17.3
Interorbital constriction	3.9 - 4.0	3.7 - 3.9
Breadth of brain case	8.3 - 8.5	7.8 - 8.2

Chimmarogale platycephala himalayica (Gray, 1842)

Himalayan Water Shrew

1842. *Crossopus himalayicus* Gray. Ann. Mag. Nat. Hist. 10: 261.

Type locality: Chamba, northeastern Punjab.

1873. *Crocidura himalaica* Anderson. Proc. Zool. Soc. London. p. 231.

Type locality: Sikkim.

1888. *Chimmarogale himalayica* Blanford. The Fauna Brit. India, Mamm. p. 245.

Type locality: Rongli, Sikkim.

Distribution: Punjab, Sikkim, Darjeeling, possibly eastern Nepal.

Nepal Records: Abe (1971, p. 395).

Habitat: River and stream banks in the temperate forests of the eastern Himalayas, from 1500 to 3000 m.

Discussion: The Himalayan water-shrew is adapted for an aquatic life. The feet have a well-developed fringe of flattened, stiff hairs on the lateral edge of each toe. The ears are reduced and a valvular antitragus for closing the openings is present.

The color of the dorsal pelage is uniform blue gray with longer white-tipped hairs sprinkled throughout the coat. The long tail is uniform brown above and the under surface is covered with white hairs similar to those that fringe the

feet. The soles of the feet are light brown. Measurements given by Blanford (1888) for this species were: HBL 110.5 mm, T 77.4 mm, HF 23.3 mm, and E 6.8 mm. The dental formula is: i. 3/1; c. 1/1; pm. 1/1; m. 3/3 = 28, and the teeth are white as in Crocidura (Allen 1938).

Little is known about the biology of this species. Water-shrews feed on small fish, tadpoles and aquatic insects and their larvae (Blanford 1888). Abe (1971) reported that the stomach contents from a single specimen contained crane fly larvae (80%) and beetles (20%).

This shrew occurs in the hill country from Darjeeling and Sikkim eastward to southern China (Allen 1938). Ellerman and Morrison-Scott (1966) also recorded collections from Kashmir and Punjab. This species may not be rare, but it is difficult to capture because of its aquatic habits.

ECTOPARASITES

None.

Nectogale elegans sikhimensis de Winton & Styan, 1899

Sikkim Water-Shrew

1888. Nectogale elegans Blanford. The Fauna Brit. India, Mamm. p. 247.

Type locality: Chuntang, Tibet.

1899. Nectogale sikhimensis de Winton & Styan. Proc. Zool. Soc. p. 573.

Type locality: Lathong, Sikkim.

Distribution: Bhutan, Sikkim, Tibet and eastern Nepal.

NEP: 4 specimens: AVWE - 4.

Habitat: The banks of mountain torrents and small streams in temperate evergreen forests; moderate elevations (1900 to 2300 m) in the eastern Himalayas.

Field Notes: Water-shrews are characterized by a long snout, reduced valvular ears, webbed feet and the abundance of long, white-tipped guard hairs that serve to shed water. The tail is modified for swimming by the development of median and lateral keels of short stiff hairs. Most remarkable are the disk-like pads on both the fore and hind feet (Allen 1938). The dorsal fur is slate gray, the lower parts of the body white from chin to tail. The prominent vibrissae are white. The feet are brown with white fringes and the tail is grayish brown above and white below.

The skull is extremely flattened with a very broad brain case. The dental formula is the same as for Crocidura. The rather slender first incisors are succeeded by long-crowned, narrow unicuspids with a prominent central cusp. The lower canines and premolars possess minute secondary cusps (Allen 1938).

Tooth specialization suggests that this insectivore is piscivorous in food habits; small fish and aquatic insects

form the bulk of the diet. Little information is available concerning the reproductive biology.

The AVWE collected the first specimens of N. elegans from Nepal. These shrews were trapped in the Arun Valley by diverting a small stream of the Kasuwa [illegible]. Nectogale may not be rare, but they are difficult to trap because of their aquatic habits. Allen (1938) found it necessary to dam off sections of small streams in order to find and dig out their burrows. According to Blanford (1888), they occur at high elevations. He reported seeing a specimen at 4545 m.

ECTOPARASITES

None.

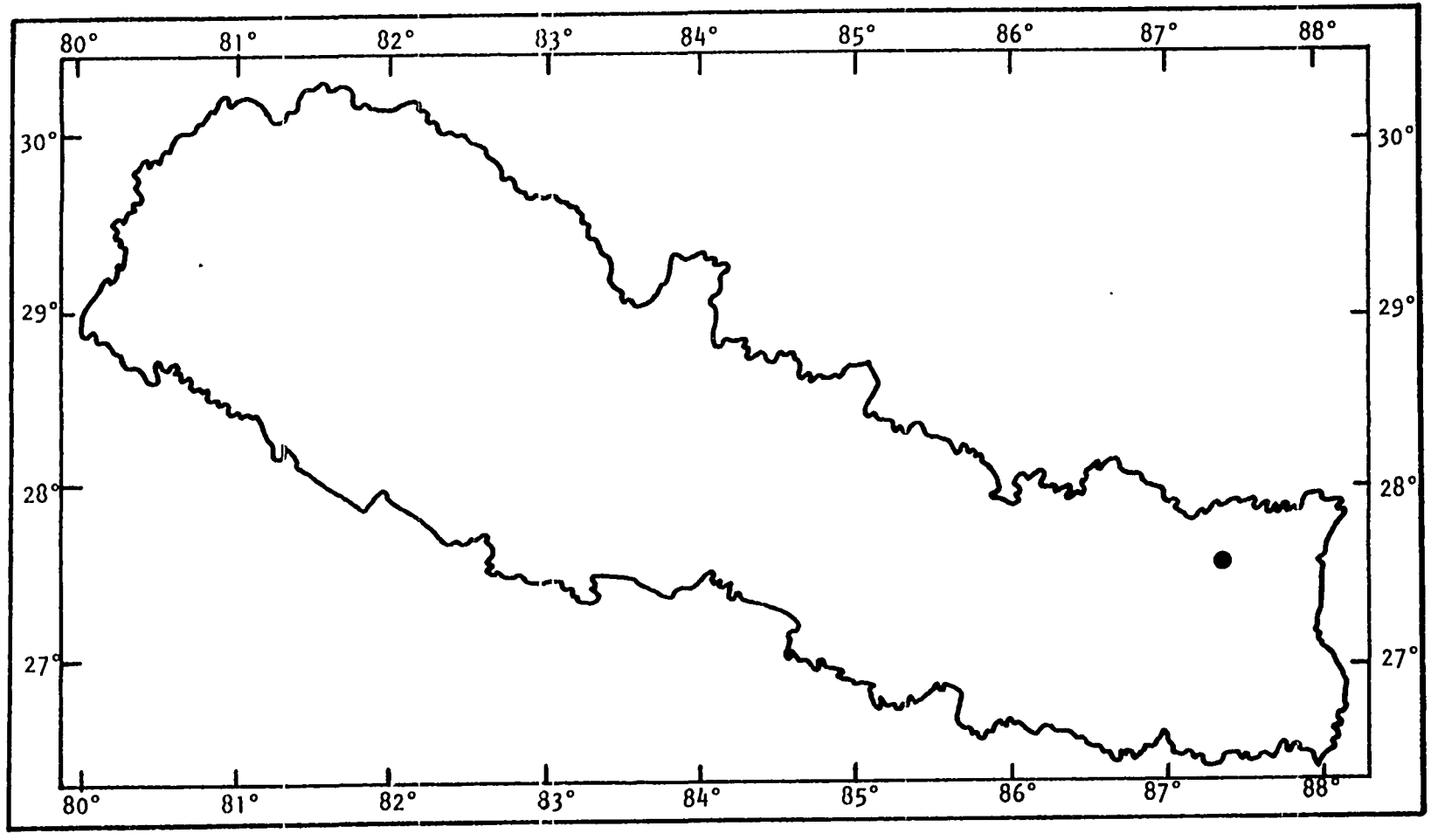


Fig. 25. Collection site for Nectogale elegans sikhimensis

ORDER PRIMATES

Macaca mulatta mulatta (Zimmermann, 1780)

Rhesus Macaque

1780. *Cercopithecus mulatta* Zimmermann. Geogr. Gesch. Mensch. 2: 195.

Type locality: India.

1792. *Simia* (*Cercopithecus*) *fulvus* Kerr. Anim. Kingd. 73.

Type locality: India.

1798. *Simia rhesus* Audebert. Hist. Nat. Singes, sig. i.

1800. *Simia erythraea* Shaw. Gen. Zool. 1:33.

1840. *Macaca* (*Pithex*) *oinops* Hodgson. J. Asiat. Soc. Bengal 9: 1212.

Type locality: Nepal Terai.

1840. *Macaca* (*Pithex*) *nipalensis* Hodgson. J. Asiat. Soc. Bengal 9: 1212.

Type locality: Nepal Terai.

1866. *Inuus sancti-johannis* Swinhoe. Proc. Zool. Soc. London. p. 556.

Type locality: North Lena Island, Hong Kong.

1868. *Macacus lasiotus* Gray. Proc. Zool. Soc. London. p. 60, pl. 6.

Type locality: Szechuan, China.

1870. *Macacus erythraeus* Swinhoe. Proc. Zool. Soc. London. p. 226.

Type locality: Hainan.

1872. *Macacus tcheliensis* Milne-Edwards. Rech. Mamm. p. 227, pls. 32, 33.

Type locality: Tcheli Province, Northeastern China.

1891. Macacus rhesus Blanford. The Fauna Brit. India, Mamm. p. 13.

1909. Pithecus littoralis Elliot. Ann. Mag. Nat. Hist. 4: 251.

Type locality: Kuatan, Fukien, Southeastern China.

1909. Pithecus brachyurus Elliot. Ann. Mag. Nat. Hist. 4: 251.

Type locality: Hainan.

1913. Pithecus brevicaudus Elliot. Rev. Primates 2: 216, pl. 23. (in place of P. brachyurus, preoccupied).

1917. Macaca siamica Kloss. J. Nat. Hist. Soc. Siam 2: 247.

Type locality: Meping Rapids, Chiengmai, Siam.

1921. Macaca mulatta Hinton and Wroughton. J. Bombay Nat. Hist. Soc. 27: 668.

Type locality: Himalayas.

1932. Macaca mulatta mulatta (Zimmermann), in Pocock. J. Bombay Nat. Hist. Soc. 35: 533.

Type locality: Rajapara, South Kamrup.

Distribution: Between 25° and 30° north latitude ranging from northeastern China, Thailand, Vietnam, Burma, Nepal, India, Pakistan into Afghanistan.

Nepal Records: Hodgson (1840, p. 1212), Hinton and Fry (1923, p. 403), Fry (1925, p. 525), Chesemore (1970, p. 164).

NEP: 4 specimens: Maser - 2; Mitchell - 2.

Habitat: The Terai and duns, extending into the Siwaliks and Mahabharat Lekh, around urban areas and the many temples

and shrines of larger cities.

Field Notes: The Rhesus macaques are squat, thick-set monkeys with males larger than females. Males are 550 to 600 mm in head and body length and weigh 7 to 10 kg. The coloration varies with individuals, but generally the dorsal parts are tawny with rufous-orange fur on the loins and rump. The lower parts are pale yellow, the face and callosities flesh-colored. During breeding season, the callosities in adults are bright red. The buttocks are naked around the area of the callosities. Large cheek pouches are present.

Macaques are the common temple monkeys of Nepal and are revered in the Hindu religion. They travel in large troops and show little fear of man. These monkeys are frequently found near cultivation. They feed on a wide variety of fruits, nuts and berries with lapsi (Choerospondias axillaris) and mauwa (Engelhardtia spicata) among their favorite food items. There does not seem to be a definite breeding season. In the western Himalayas, mating generally takes place between August and September and most of the young are born between March and May. Walker et al. (1964a) reported a gestation period of five to seven months and there is usually only one infant.

Rhesus monkeys emit several calls: Two in particular are the deep-bark threat call and the high-pitched, whine alarm call. These monkeys readily take to water and are good swimmers.

ECTOPARASITES

Siphonaptera: *Ctenocephalides felis orientis*

Macaca assamensis pelops (Hodgson, 1840)

Assamese Macaque

1840. *Macacus* (*Pithex*) *pelops* Hodgson. J. Asiat. Soc. Bengal 9: 1213.

Type locality: Nepal Kachar.

1870. *Macacus problematicus* Gray. Cat. Monkeys, etc. B. M. 128.

Type locality: Dhalimkot, Bhutan.

1872. *Macacus rheso-similis* Sclater. Proc. Zool. Soc. London. p. 495, pl. 25.

Type locality: East Indies.

1891. *Macacus assamensis* Blanford. The Fauna Brit. India, Mamm. p. 15.

1939. *Macaca assamensis pelops* (Hodgson), *in* Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 55.

Distribution: The Himalayas; from Mussoorie through Nepal, Darjeeling, Sikkim and Bhutan.

Nepal Records: Hodgson (1840, p. 1213).

NEP: 1 sighting: Mitchell - 1.

Habitat: The Siwalik foothills and Mahabharat Lekh, between 600 and 1800 m. Along the major rivers of the eastern Terai; in oak-rhododendron forests of the western midlands.

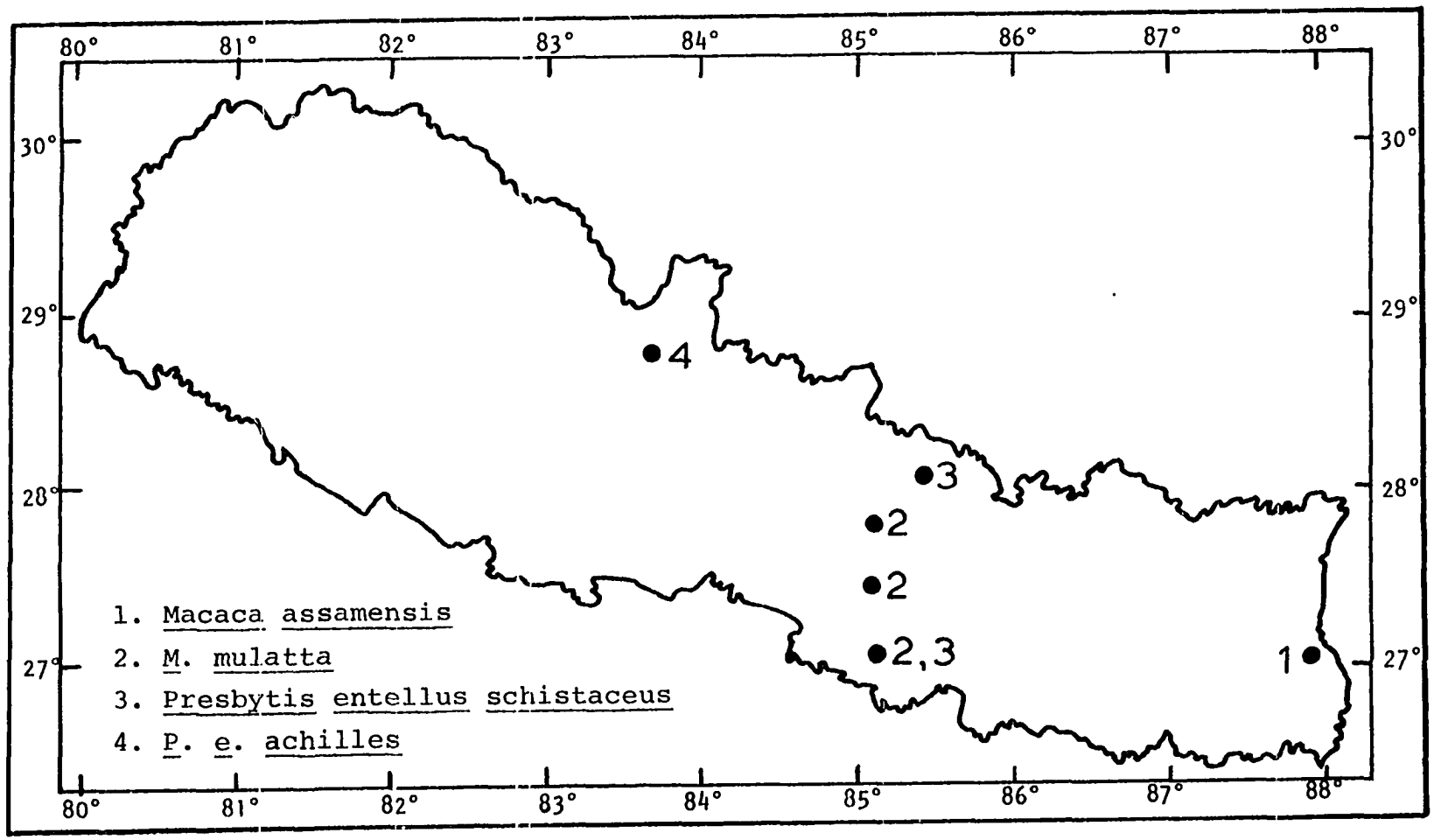


Fig. 26. Collection sites and sightings for family Cercopithecidae

Discussion: Woolly macaques are larger both in body and skull size than Macaca mulatta and are distinguished from it as well by the absence of the orange-red hue on the loins and rump. Males may attain a length of 750 to 800 mm and weigh up to 12 kg (Prater 1965). The color is uniform brown with a slight yellowish tinge and the pelage is thick with long, black-tipped hairs. Pocock (1939) listed the length of the pelage as 55 to 70 mm.

These monkeys are shyer than rhesus macaques and avoid human habitation. They usually inhabit dense forests living in troops of 15 to 35. The diet is a mixture of fruits and vegetable matter.

Hodgson (1840) was the first to report the occurrence of woolly macaque in Nepal. In 1966, a band of these monkeys was sighted in the Mahabharats of western Nepal. In December of 1968, a large troop was seen near the Tista River along the Nepal-Darjeeling border. In a personal conversation, Dr. Fleming, Sr. reported seeing a troop of woolly macaques in the Jhapa District of the eastern Terai.

Presbytis entellus schistaceus (Hodgson, 1840)

Langur or Languar

1840. Semnopithecus schistaceus Hodgson. J. Asiat. Soc. Bengal 9: 1212.

Type locality: Nepal Terai.

1840. Semnopithecus nipalensis Hodgson. J. Asiat. Soc. Bengal 9: 1212.

Type locality: Nepal Terai.

1928. Pithecus entellus hector Pocock. J. Bombay Nat. Hist. Soc. 32: 481.

Type locality: Sitabaini, Ramnagar, Kumaon.

1939. Semnopithecus entellus schistaceus Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 92.

Type locality: Kumaon and Garhwal, Northern India.

1966. Presbytis entellus schistaceus (Hodgson), in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 205.

Presbytis entellus achilles (Pocock, 1928)

The Himalayan Languar

1891. Semnopithecus schistaceus Blanford. The Fauna Brit. India, Mamm. p. 30.

1928. Pithecus entellus achilles Pocock. J. Bombay Nat. Hist. Soc. 32: 478.

Type locality: Satthar, Gorkha, 50 miles N. W. Kathmandu, Nepal.

1939. Semnopithecus entellus achilles Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 95.

Type locality: Gorka, Nepal.

1966. Presbytis entellus achilles (Pocock), in Ellerman and Morrison-Scott. Checklist Palaeractic and Indian Mamm. 2nd ed. p. 205.

Distribution: Nepal, Sikkim, Kumaon, Garhwal, possibly Kashmir.

Nepal Records: Hodgson (1840, p. 1212), Hinton and Fry

(1923, p. 404), Fry (1925, p. 525), Pocock (1928, p. 478), Chesemore (1970, p. 164).

NEP: 3 specimens: Mitchell - 3.

Habitat: The Terai, duns, Siwaliks, Mahabharat Lekh, midlands and Tibetan Plateau; from 100 to 4000 m.

Field Notes: Two subspecies of languars are recognized for Nepal: P. e. schistaceus of the Terai and P. e. achilles of the middle Himalayas (2000 to 3500 m). According to Blanford (1891), achilles differs from schistaceus by (1) a somewhat larger size, (2) a much paler head, (3) smaller ears concealed by long hair of cheeks and (4) form of skull.

Languars are the long-limbed, long-tailed, black-faced monkeys common to the sal forests of the Terai and the oak-rhododendron forests of the midlands. Individuals range from 900 to 1100 mm in total length and weigh up to 15 kg. The head, body, limbs and tail are pale earthy or grayish brown. Specimens from the midlands have pale to almost white heads which stand out in contrast to the darker color of the body. The hands, feet and face are always black.

Languars travel in large troops of 15 to 50 and are more arboreal than macaques. They readily take to the ground and when disturbed flee to trees. Older males advance growling and barking, while females and young take cover amid a din of hoots and whines. Once in the trees, they leap with surprising agility from branch to branch. When pressed, they

make astonishing jumps and have been seen to leap from tree to tree, a distance of 7 to 10 m. They are strictly vegetarians feeding on fruits, flowers, buds, shoots and leaves.

According to Prater (1965), mating in the lowlands takes place throughout the year. There is a definite breeding season in the colder parts of the range. In the Terai, languars generally mate during March and April. Walker et al.(1964a) listed a gestation period of 196 days. At higher altitudes, young are usually born from April through June (Prater 1965).

In the Langtang Valley, languars have been seen at elevations of 3500 to 4200 m and at Jomosom, Mustang District, an old male was seen at 4700 m.

ECTOPARASITES

None.

ORDER PHOLIDOTA

Manis pentadactyla aurita Hodgson, 1836

Chinese Pangolin

1836. Manis auritis Hodgson. J. Asiat. Soc. Bengal 5: 234.

Type locality: Lower and Central Nepal.

1842. Manis javanica Blyth. J. Asiat. Soc. Bengal 11: 454.

1843. Manis dalmanni Sundevall. Vet. Akad. Handl. Stockholm. 1842: pp. 256, 278, pl. 4, fig. 10.

Type locality: Near Canton, southern China.

1872. Pholidotus assamensis Fitzinger. Akad. Wiss. Wien. p. 57.

1891. Manis aurita Blanford. The Fauna Brit. India, Mamm. p. 599.

1907. Pholidotus kreyenbergi Matschie. Wiss. Ergebn. Exped. Filchner to China 10(1): 234.

Type locality: Nanking, Kiangsu, China.

1966. Manis pentadactyla aurita Hodgson, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 214.

Distribution: Southern China, Southeast Asia, Burma, Assam, Sikkim, Darjeeling, Nepal.

Nepal Records: Hodgson (1836c, p. 234).

NEP: 1 skeleton: Mitchell - 1.

Habitat: The hills of the central tract (Hodgson 1836c); the humid regions of the central and eastern midlands from 900 to 1800 m.

Discussion: The most distinctive characteristic of the pangolin is the armor of protective scales: the upper part of the head, the back and sides of the body, the whole tail and the outside of the limbs are covered with large overlapping scales. The animal also protects itself by curling into a ball. It is armed with long, curved claws which are used for digging. All of the limbs have five, clawed digits. Females have a single pair of mammae. The skull is conical in shape and lacks teeth.

Pangolins are strictly nocturnal, spending the day curled up in a burrow excavated in moist, soft soil. According to Prater (1965), the burrow entrances are closed when they are inside. Their food consists of termites and ants and their eggs and larvae.

Usually one offspring is born in the spring, but sometimes there are two (Allen 1938). When alarmed, the mother cuddles the offspring inside her rolled up body (Walker et al. 1964a). Young ride on the back or on the tail of the mother.

Pangolins are more common than generally believed. Due to their nocturnal habits and burrowing activities, they are seldom encountered. Hodgson (1836c) was the only investigator to collect the pangolin from Nepal. In 1970, the skeleton of a specimen was purchased at Gulu Bhajang, central midlands. Pangolins are usually found in the tea gardens of

Darjeeling, eastern Himalayas. Natives use parts of these animals for medicinal purposes.

ECTOPARASITES

None.

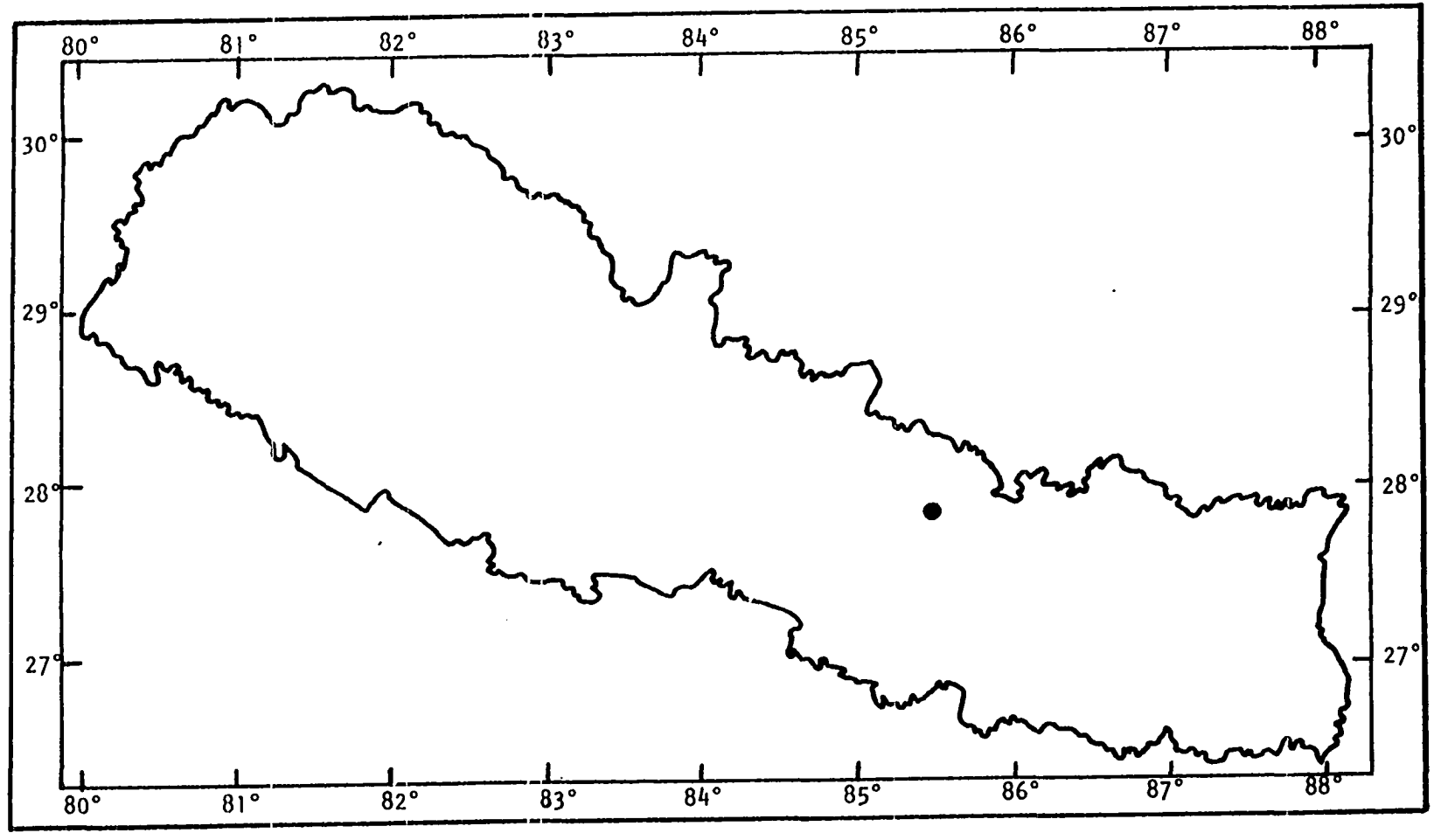


Fig. 27. Sighting for Manis pentadactyla aurita

ORDER LAGOMORPHA

Lepus nigricollis ruficaudatus Geoffroy, 1826

Indian Hare; Rufous-tailed Hare

1826. *Lepus ruficaudatus* Geoffroy. Dict. Class. H. N. 9: 381.

Type locality: Bengal.

1840. *Lepus macrotus* Hodgson. J. Asiat. Soc. Bengal 9: 1183.

Type locality: Gangetic Plain, India.

1844. *Lepus aryabertensis* Hodgson. J. Nat. Hist., Calcutta 4: 293.

Type locality: Madhyades, Nepal.

1846. *Lepus indicus* Gray. Cat. Hodgson's Coll. B. M. p. 20.

1854. *Lepus tytleri* Tytler. Ann. Mag. Nat. Hist. 14: 176.

Type locality: Dacca.

1964. *Caprolagus* (*Indolagus*) *ruficaudatus* Gureev. Akad. Nauk. S.S.S.R. p. 142.

1966. *Lepus nigricollis ruficaudatus* Geoffroy, *in* Ellerman and Morrison-Scott. Checklist Palaearctic and Indian Mamm. 2nd ed. p. 437.

Distribution: Kumaon, Nepal, Sikkim, Bhutan Duars, Bangladesh, West Bengal, and Central India.

Nepal Records: Hodgson (1834b, p. 97), Hinton and Fry (1923, p. 423), Fry (1925, p. 530), Chesemore (1970, p. 164).

NEP: 18 specimens: Mitchell - 13; Maser - 5.

Habitat: Tracts of scrub jungle alternating with cultivated fields of the Terai and duns, extending into the

midlands; from 100 to 2400 m.

Taxonomic Notes: If Petter's (1961) classification of the European and Asiatic hares of the subgenus Lepus, which is based solely on the structure of the groove on the anterior surface of the upper incisor, is followed, hares with a complex groove are assigned to the Indian species L. nigricollis and those with a simple groove to six other species. Petter felt that the large group of hares in India and Sri Lanka, of which the prior name is L. nigricollis, are members of the europaeus group. He contended that L. nigricollis has all the essential characters of the europaeus group, including a very large sized skull, and that it might represent a further eastward extension of europaeus.

Lay (1967) reported valid objections to the uncritical use by Petter of the structure of this groove on the upper incisor. Lay contended that Petter based his revision on too small a sample, which failed to account for age or geographic variation within the key character. Hall (1951) presented evidence that within a single species of this Holarctic subgenus (Lepus) the groove may be simple or complex, depending upon whether the specimen came from east or west of a particular mountain range.

Hassinger (1973) examined the incisive groove of 89 Eurasian hares in the Chicago Field Museum of Natural History. He divided them into: (1) simple grooves with no cement

filling or single cement-filled invaginations and (2) complex grooves, usually bi- or trifurcated. Hassinger found simple grooves in each of the 32 skulls from the Palaearctic Region. Of 48 hares collected in or near the Himalayan portion of the transition between the Palaearctic and Oriental Regions, 18 had simple grooves, 19 a single invagination and 11 complex grooves. One hare from the Oriental Region had a single invagination, eight had complex invaginations.

Petter (1961) classified L. nigricollis ruficaudatus as having a simple groove. Hassinger (1973) found complex grooves in each of the sample of four L. nigricollis ruficaudatus from northern India (Assam), thus supporting Tate (1947), who distinguished this species as having complex grooves. Lay (1967) and Hassinger (1973) contradicted the use of incisive grooves used by Petter as a valid character to distinguish L. nigricollis ruficaudatus from other hares.

Gureev (1964) placed L. nigricollis ruficaudatus in the genus Caprolagus. Ellerman and Morrison-Scott (1966) distinguished between Lepus and Caprolagus on the basis of the least longitudinal diameter of the palate and the width of the mesopterygoid space. In Caprolagus the mesopterygoid region is narrow and the width of the space immediately behind the palate is much shorter than the least longitudinal diameter of the palatal bridge. The palatal bridge averages

more than 130% of the mesopterygoid width. In Lepus the mesopterygoid region is wider, the width of the space immediately behind the palate is more or less equal in length to the palatal bridge and the palatal bridge averages less than 130%. Of the 13 Nepalese specimens of L. nigricollis ruficaudatus examined, the palatal bridge was 112 to 125% of the mesopterygoid width. Gureev (1964) probably erred in placing L. nigricollis ruficaudatus in the genus Caprolagus.

Field Notes: The Indian hare has a rufous brown coat mixed with black on the face and back. The chest and limbs are rufous with white on the chin, upper throat and belly. The upper surface of the tail is rufous brown. Males are slightly smaller than females. Three pairs of mammae are present, one pectoral and two inguinal.

This hare is found chiefly in scrub jungle and the dry, cultivated plains of the Terai and duns. The diet consists of grasses and herbaceous matter. Nocturnal in habits, the Indian hare sleeps during the day in a hollow it excavates.

Mating is restricted to the milder periods of the year, although members of this genus breed in every month (Walker et al. 1964b). Females produce litters of one to two young. Two females taken on 2 and 11 April in the western Terai bore two and one embryos, respectively. On 23 September a lactating female was collected from the Kathmandu Valley.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis
	C. f. orientis
Ixodoidea:	Dermacentor auratus
	Haemaphysalis bispinosa
	H. howletti
	H. indica
	H. ornithophila
	H. wellingtonii
	H. sp.
	Hyalomma sp.
	Rhipicephalus haemaphysaloides
Anoplura:	Haemodipsus lyriocephalus
	H. ventricosus

Lepus oiostolus oiostolus Hodgson, 1840

Woolly Hare

1840. Lepus oiostolus Hodgson. J. Asiat. Soc. Bengal 9: 1186.

Type locality: unknown locality, southern Tibet.

1842. Lepus pallipes Hodgson. J. Asiat. Soc. Bengal 11: 288.

Type locality: Utsang, Eastern Tibet.

1846. Lepus oemodias Gray. Cat. Hodgson's Coll. B. M. p. 21.

1875. Lepus hypsibius Blanford. J. Asiat. Soc. Bengal 44 (2): 214.

Type locality: Kuim, Changchemno Valley, Ladak.

1899. Lepus sechuenensis de Winton. Proc. Zool. Soc. London. p. 576, pl. 32.

Type locality: Dunpi, Northwestern Szechuan, China.

1907. Lepus kozlovi Satunin. Ann. Mus. Zool. Acad. St. Petersb. 11: 162.

Type locality: Retschu River, Kam Province, Southeastern Tibet.

Distribution: Tibet, Szechuan, Sikkim, Mustang District of Nepal, Kashmir (Ladak).

Nepal Records: Gray (1846, p. 21), Thomas and Hinton (1922, p. 183).

NEP: 4 specimens: Mitchell - 4.

Habitat: The alpine desert region of the Mustang District from 3000 to 4200 m.

Taxonomic Notes: According to Allen (1938), this hare appears externally similar to L. europaeus tolai of the Gobi, but is distinguished by the much longer ears and longer hind feet. The skull is larger, with a more elongated rostrum, longer tooth rows, and more erect and flaring supraorbital processes. The woolly hare is limited to the Tibetan steppe, just reaching the high country of extreme western China, while L. e. tolai is distributed throughout the Gobi of Mongolia.

Field Notes: The fur is soft, thick and woolly and the color is a light yellowish brown mixed with dark brown above; the rump is ash gray. The tail is almost entirely white, except for a narrow ash gray stripe on the dorsal surface. There is a whitish ring around each eye and an ill-defined mixed gray and blackish area between the eyes and the vibrissae of the muzzle.

During the day, woolly hares take shelter among rocks

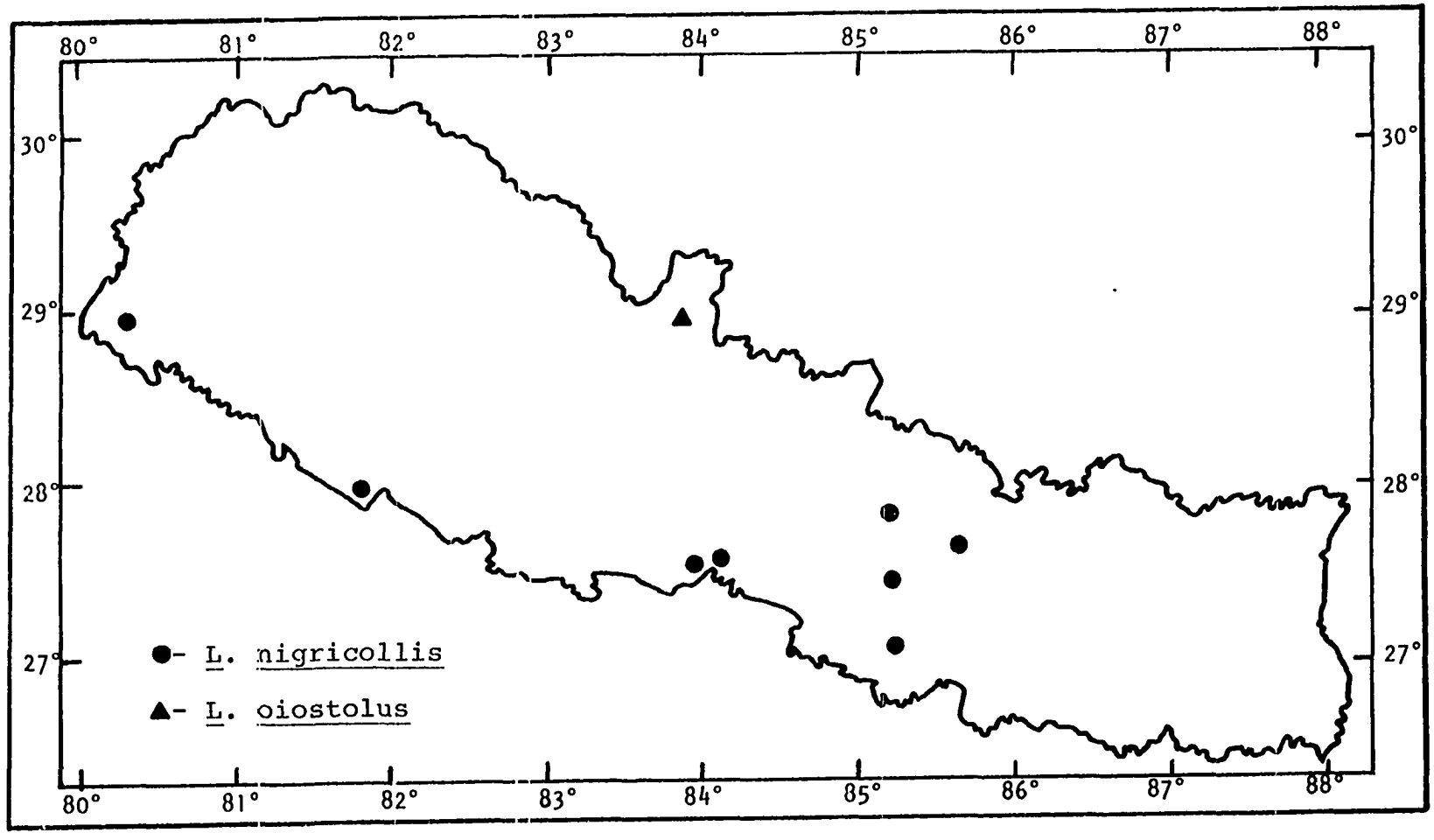


Fig. 28. Collection sites for Lepus sp.

and brush along river bottoms, and at night they feed in wheat fields. On 12 March, 1970 two females were collected near Mustang village; an additional two specimens were taken on 2 June at Jomosom.

ECTOPARASITES

Siphonaptera:	Amphipsylla n. sp. Ceratophyllus enefdei Euhoplopsyllus glacialis profugus
Ixodoidea:	Anomalohimalaya lama Dermacentor everestianus Ixodes sp.
Anoplura:	Haemodipsus lyriocephalus

Caprolagus hispidus (Pearson, 1839)

Assam Rabbit, "Hispid Hare"

1839. Lepus hispidus (Pearson), in M'Clelland. Proc. Zool. Soc. London. p. 152.

Type locality: Foot of Himalayas, Northern Assam.

1845. Caprolagus hispidus Blyth. J. Asiat. Soc. Bengal 14: 249.

1863. Lepus (Caprolagus) hispidus Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 11.

Type locality: Sal forest, Nepal.

Distribution: The base of the Himalayas, Kumaon, Nepal Terai to Upper Assam.

Nepal Records: Gray (1863b, p. 11).

Habitat: The tract of sal forests along the foot of the Himalayas, from 100 to 800 m.

Discussion: The Assam rabbit is closely related to true rabbits; but differs in that there is no clear notch in front of the postorbital processes, the frontal bones are very wide, the occipitonasal length generally exceeds 85 mm and the auditory bullae are relatively small (Ellerman and Morrison-Scott 1966).

The Assam rabbit is the same size as the Indian hare (Lepus nigricollis), but it has a much shorter tail (Prater 1965). The fur is short and bristly and the ears are shorter than the hind foot. Dorsally, the fur is black mixed with brownish white. The lower parts are brownish white and the tail brown.

The habits of this rabbit are not well-known and nothing has been recorded on the breeding biology. According to Blanford (1891), this species inhabits sal forests while Jerdon (1867) believed that the "hispid hare" is found in marshy tracts of the Terai. The food consists chiefly of tree roots and bark (Hodgson 1847c).

This species was once found along the foot of the Himalayas from Uttar Pradesh to Assam. Presently it is thought to be extinct. The last record of the Assam rabbit was in 1951 from Kheri on the Nepal-Uttar Pradesh borders (Prater 1965). Gray (1863b) reported the only collection of the Assam rabbit from Nepal.

Ochotona roylei roylei (Ogilby, 1839)

Royle's Pika, Himalayan Mouse-hare

1839. Lagomys roylii Ogilby. Royle's Ill. Botany Himalaya LXIX, pl. 4.

Type locality: Choor Mountains, 60 miles north of Saharanpur, Punjab.

1841. Lagomys hodgsoni Blyth. J. Asiat. Soc. Bengal 10: 817, plate on p. 844.

Type locality: Kashmir.

1841. Lagomys nepalensis Hodgson. J. Asiat. Soc. Bengal 10: 854, pl. on p. 816.

Type locality: ca 30 miles N. Kathmandu, Nepal.

1842. Lagomys nipalensis Hodgson. Ann. Mag. Nat. Hist. 10:76

Type locality: Gosainkunde, Central Nepal.

1891. Lagomys roylei Blanford. The Fauna Brit. India, Mamm. p. 456.

1904. Ochotona roylei Bonhote. Proc. Zool. Soc. London 1904 (2): 217.

Type locality: Kashmir.

1922. Ochotona roylei nepalensis Thomas and Hinton. Ann. Mag. Nat. Hist. London 9: 184 (new syn.)

Type locality: Nepal.

Ochotona roylei wardi Bonhote, 1904

1904. Ochotona wardi Bonhote. Abstr. Proc. Zool. Soc. London 10:13. 1905, Proc. Zool. Soc. London 1904 2: 214.

Type locality: Talien, Kashmir.

1966. Ochotona roylei wardi (Bonhote), in Ellerman and Morrison-Scott. Checklist Palaearctic and Indian Mamm. 2nd ed. p. 451.

Distribution: Kashmir, Punjab, Kumaon, Nepal, possibly Sikkim and Tibet.

Nepal Records: Hodgson (1841e, p. 854; 1842b, p. 76), Gray (1846, p. 21), Thomas and Hinton (1922, p. 184), Hinton and Fry (1923, p. 424), Fry (1925, p. 530), Worth and Shah (1969, p. 127), Gruber (1969, p. 262), Chesemore (1970, p. 164), Abe (1971, p. 404).

NEP: 143 specimens: Mitchell - 125; Maser - 14; AVWE - 4.

Habitat: The moist alpine regions of the midlands and inner Himalayas; rocky biotopes from tree line to alpine meadows, 2700 to 4900 m.

Taxonomic Notes: Two subspecies of Ochotona roylei are recognized from Nepal: O. r. roylei and O. r. wardi. Ochotona roylei wardi, a somewhat larger, gray pika, occurs in western Nepal, Kumaon and Kashmir, while O. r. roylei, a smaller reddish pika, is found in central and eastern Nepal. Ochotona roylei wardi has a longer head and body length, a shorter hind foot, and a shorter upper tooth row than O. r. roylei (Gruber 1969).

Field Notes: The typical form of this species has a reddish brown coat with a pale band over the nape. However, there is considerable seasonal variation in color. The summer pelage is usually a bright rufous or hazel with the winter coat a dark brown grizzled with buff. Molting, described in detail by Gruber (1969), takes place in autumn

(September to mid-October) and spring (May through June). The feet are pale brown above and the soles darker brown. The ears are frequently edged with a narrow whitish border. Two pairs of mammae are present, one inguinal and the other pubic.

In the skull, the palatal and incisive foramina are fused, the rostrum is short and fenestrae frontalis are present.

Himalayan mouse-hares are common throughout the sub-alpine and alpine regions of the inner Himalayas. Gregarious in habit, they live in colonies, preferring stony boulder biotopes, but readily make their nests in the religious stone heaps (mani stones) and cow huts found at high altitudes. Worn paths lead to the main gallery or burrow, which is usually situated beneath a large boulder. In addition to a main burrow, there are several side exits.

Pikas collect reserves of plants and coarse grasses, which they store in small heaps or "hay stacks'. They were seen to feed on green herbs, forbs and mosses. There are also localized areas for the deposition of feces. Pikas do not hibernate and individuals were seen hopping about during winter. Their alarm call is an extremely high-pitched, piercing whistle.

One to two litters of one to five young are produced annually. Usually the average litter size is three. A

female collected on 11 May had five embryos. In August, 20% of the females collected bore embryos, while another 10% were lactating. About 20% of the August catch were immatures, suggesting that there is a pre-monsoon (May-June) breeding season. In September, females with young were observed. Approximately 18% of the females trapped in September bore uterine scars. Males with enlarged testes were trapped in August and September.

Hunting proved to be the most effective method of collecting pikas. A few specimens were taken by trapping. Two specimens were kept in captivity from 7 August until 13 September. They were fed on alpine flowers, grasses and strawberry leaves. Both specimens were transported to the Kathmandu Valley and they expired after five and seven days. The change in altitude was probably the cause of death. In Nepal, pikas were never collected or sighted below 2500 m.

The Siberian weasel (Mustela sibirica) and yellow-throated marten (Martes flavigula) prey upon Ochotona. Both of these mustelids were trapped near pika dens and were commonly infested with lagomorph ectoparasites.

ECTOPARASITES

Siphonaptera:
- Amphalius clarus
- Citellophilus mygala
- Chaetopsylla gracilis
- Ctenophyllus n. sp.
- Ctenophyllus triangularis
- Doratopsylla coreana

	Genoneopsylla longisetosa
	Neopsylla marleaneae
	N. pagea
	Paradoxopsyllus acanthus
	P. digitatus
	Paraneopsylla ioffi nepali
	Rhadinopsylla n. sp. 1
	R. n. sp. 2
	Xenodaeria telios
Ixodoidea:	Ixodes hyatti
	I. lindbergi (="ovatus")
	I. shahi
	I. sp.
Parasitoidea:	Haemogamasus nidiformis
	H. oliviformis
	H. suncus
	Histionyssus latiscutatus
	Laelaps sp.
	L. turkestanica
	Myonyssus montanus
	Macrochelidae
Anoplura:	Hoplopleura acanthopus
	H. ochotonae

Ochotona macrotis wollastoni Thomas and Hinton, 1922

Mount Everest Mouse-hare

1922. Ochotona wollastoni Thomas and Hinton. Ann. Mag. Nat. Hist. 9: 184.

Type locality: Kharta Valley, Tibet; East of Mt. Everest.

1966. Ochotona macrotis wollastoni Thomas and Hinton, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 451.

Distribution: Tibet; east of Mt. Everest, Mustang District, possibly northern Nepal.

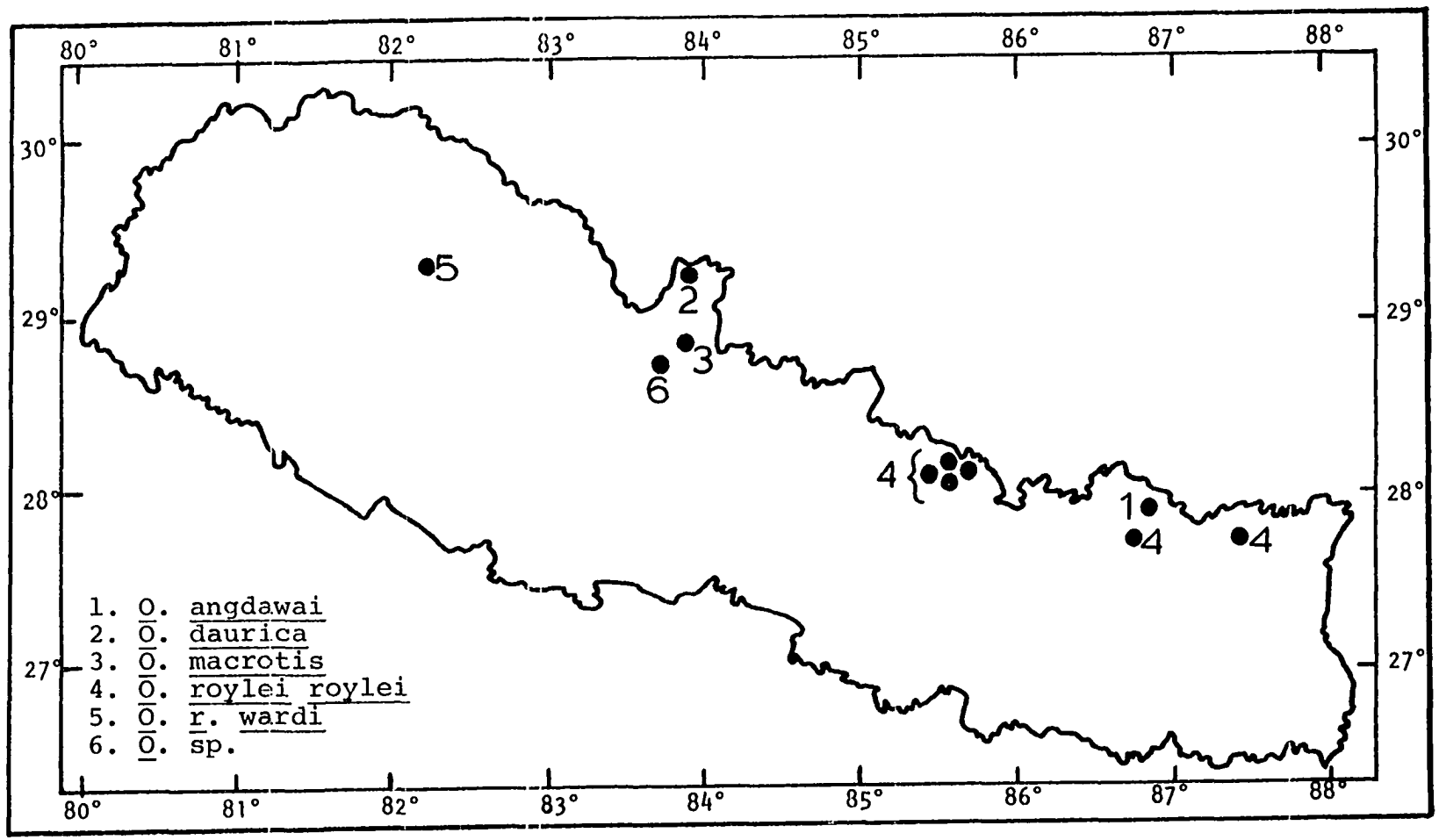


Fig. 29. Collection sites for Ochotona sp.

Nepal Records: Biswas and Khajuria (1957, p. 241), Abe (1971, p. 402).

NEP: 1 specimen: Mitchell - 1.

Habitat: The alpine desert biotope of Mustang District; inhabits rocky outcroppings and talus slides.

Taxonomic Notes: Ochotona macrotis is approximately the same size as O. roylei, but differs in color, and in having a slightly larger skull, much larger ears and in habitat preference. Vinogradov and Argyropulo (1968) stated that O. macrotis is closely related to O. roylei and only lack of material prevented them from uniting these two species. Bonhote (1904) used the presence of two small oval foramina above and in front of the orbit at the anterior end of the frontal bones as a criterion to separate O. macrotis from O. roylei. This character varies individually, as shown by Gruber (1969). Ellerman and Morrison-Scott (1966) contended that the character is taxonomically valueless.

Field Notes: In color Ochotona macrotis is light gray with a slightly drab tinge. The ventral pelage is pale, somewhat whitish. The ear is black with a white fringe and is never less than 27 mm in length. The average length of the ear is 30 to 36 mm. The feet are white with charcoal soles.

The length of the skull approximates 47 mm and the interorbital space is flat and broad (5.2 to 6.0 mm). The palatine and incisive foramina are fused.

Large-eared pikas inhabit the Tibetan steppe biotope and they frequent open, rocky ground and boulder heaps. Little is known about the food habits and breeding biology. In the Russian Pamirs, they were found to cut and dry the leaves of Corydalus sp. for food (Ognev 1940). One to two litters are produced each year and the litter size is one to four.

On 3 March, a single male specimen was collected from Muktinath, Mustang District. Other collection records of O. macrotis from Nepal are Biswas and Khajuria (1957) from the Mt. Everest region and Abe (1971) from the Gosainkund Lakes. Both parties collected a single specimen with an ear length less than 27 mm. These two specimens have ear lengths that fall in the range for O. roylei (range: 18.8 to 25.2 mm; mean: 23.2 mm) and it appears that these two specimens are not O. macrotis, but are probably a gray phase of O. roylei.

ECTOPARASITES

Siphonaptera:	Chaetopsylla gracilis
	Neopsylla angustimanibra
Ixodoidea:	Ixodes hyatti
	I. shahi

Ochotona daurica curzoniae (Hodgson, 1858)

Hodgson's Mouse-hare

1858. Lagomys curzoniae Hodgson. J. Asiat. Soc. Bengal 26: 207.

Type locality: Chumbi Valley in extreme southern Tibet.

1966. Ochotona daurica curzoniae (Hodgson), in Ellerman and Morrison-Scott. Checklist Palaearctic and Indian Mamm. 2nd ed. p. 452.

Distribution: Southern Tibet, Chumbi Valley of Sikkim, Mustang District of Nepal.

NEP: 5 specimens: Mitchell - 5.

Habitat: The Tibetan steppe biotope; along the ravines and depressions of river valleys.

Field Notes: This medium sized pika (170 to 190 mm), is a light sandy brown dorsally and nearly white ventrally. The basal half or more of the fur is charcoal. The longer dorsal hairs are black tipped. The ears are charcoal and edged in white. The toe pads are concealed by long, dense white hair.

The dorsal profile of the skull is arched and the palatal and incisive foramina are confluent. The length of the palate usually does not reach 17 mm. The incisive foramen is the same as in O. roylei, but the orbits are smaller and much closer together. The nasals are also shorter and the upper surface of the skull more convex.

These pikas prefer the xeric condition of the Tibetan

Plateau and make their burrows in patches of grass and thickets of iris. They are gregarious and form large colonies, preparing stacks of hay from the surrounding vegetation -- grasses, flowers and Artemisia.

More than one litter is produced annually with a litter size of two to five. Young are probably born from May through August. On 30 May, a very small immature (TL: 108.1 mm) was collected.

Five specimens were taken from the Mustang District; this was the first record of Ochotona daurica curzoniae from Nepal, thus extending the known range by approximately 250 km west. Previous collections were taken from Sikkim and Tibet.

ECTOPARASITES

Siphonaptera: Amphipsylla guadratedigita
Ceratophyllus fringillae

Ochotona angdawai Biswas and Khajuria,1955

Ang Dawa's pika

1955. Ochotona angdawai Biswas and Khajuria. Proc. Zool. Soc. Calcutta 10: 26.

Type locality: Khumbu Glacier, Solukhumbu District, Nepal.

Distribution: The Mt. Everest region of Solukhumbu District, eastern Nepal.

Nepal Records: Biswas and Khajuria (1955, p. 10).

Habitat: The glaciated alpine region of the high Himalayas.

Discussion: Biswas and Khajuria (1955) described a new species of Ochotona, based upon a single specimen from the Mt. Everest Region. According to them, Ochotona angdawai is distinguished from all other species of the genus by the presence of a grayish black band, about 5 mm wide across the face. They said, "O. angdawai differs from O. roylei mainly on the presence of the grayish black facial band and in having much longer fur, especially on the soles of the feet. It is also much smaller in size than all known races of O. roylei. The skull is similar to that of O. roylei. There are two pairs of frontal fenestrae, an anterior and posterior pair."

Since the skull measurements of O. andgawai, with the exception of the upper tooth row and the bullae, approach those of O. roylei (Table 8), I believe that O. angdawai represents an immature gray form of Royle's pika. Gray forms of O. roylei have been collected in Nepal. O. angdawai was taken during February at a high altitude; this could account for the long pelage. On 30 October, 1969, a gray pika with long pelage was collected near the type locality (Solukhumbu glacier) of O. angdawai. Unfortunately, rats destroyed the skull, so the identity of the specimen was never ascertained.

Table 8. Comparison of skull measurements of Ochotona angdawai to those of O. roylei (in mm).

	O. angdawai	O. roylei (5 specimens)
Occipitonasal length	42.5	41.7 - 42.8
Diastema	9.7	9.7 - 10.0
Palatal Foramen	12.2	12.2 - 12.5
Bulla	9.5	9.8 - 9.9
Upper tooth row	7.5	7.8 - 8.3
Condylobasal length	42.5	40.5 - 42.8

Ochotona sp.

Distribution: Jomosom, Mustang District of Nepal.

NEP: 4 specimens: Mitchell - 4.

Habitat: The arid alpine region of Jomosom.

Taxonomic Notes: In 1922, Thomas described several new taxa of Ochotona from the Himalayas. Ellerman and Morrison-Scott (1966) listed 12 species of pikas from Asia and Bonhote (1904) divided the genus into three groups on the basis of the shape of the incisive and palatal foramina: (1) the ladacensis group, (2) the rufescens group and (3) the curzoniae group.

In the ladacensis group, the incisive and palatal foramina are separate and distinct. In the rufescens group,

there is no bony division between the incisive and palatal foramina, but the incisive foramen is narrow and slightly constricted at its posterior end. It suddenly broadens out into what represents a large palatal foramen. The curzoniae group has a large, single foramen that is practically triangular in shape, with little or no constriction to make the division between the incisive and palatal foramina.

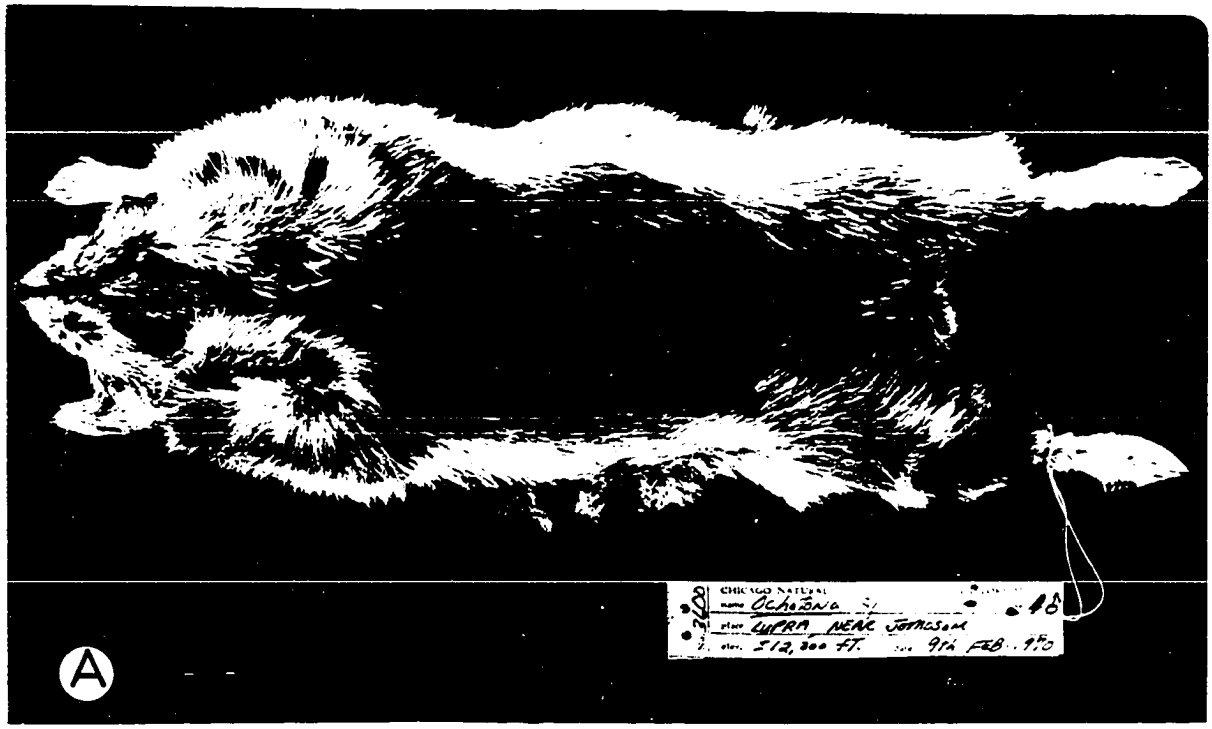
A pika collected from the Tibetan steppe biotope of the Mustang District differs considerably from other Ochotona reported from Asia and the Himalayas in cranial features, overall size and habitat preference. Ochotona sp., on the basis of the shape of the incisive and palatal foramina, belongs to the curzoniae group along with O. daurica, O. macrotis, O. roylei and O. thibetana.

Field Notes: Ochotona sp., a medium sized pika (Fig. 30A), is brownish red with black hairs interspersed throughout the coat. The base of all hairs is charcoal black. The flanks are straw gray and the belly is yellowish.

Ochotona sp. differs cranially from all the other members of the curzoniae group. The skull is of medium length and narrow in width, with a flat dorsal profile. (Fig. 30B). The auditory bullae are large and inflated, averaging 26% or more of the occipitonasal length (Fig. 30C). Three of the four species belonging to the curzoniae group were collected from Nepal. Skull measurements were obtained for these three

Fig. 30. Ochotona sp. skin and skull

A. Skin (.75X)
B. Dorsal view of skull (2.4X)
C. Ventral view of skull (2.4X)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name Ochotona
plac LAMPA NEAR JOHNSON
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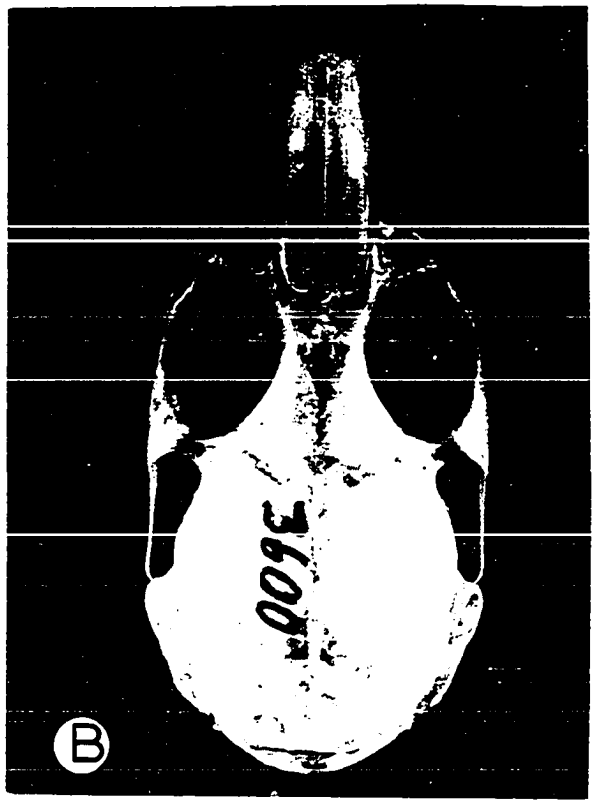
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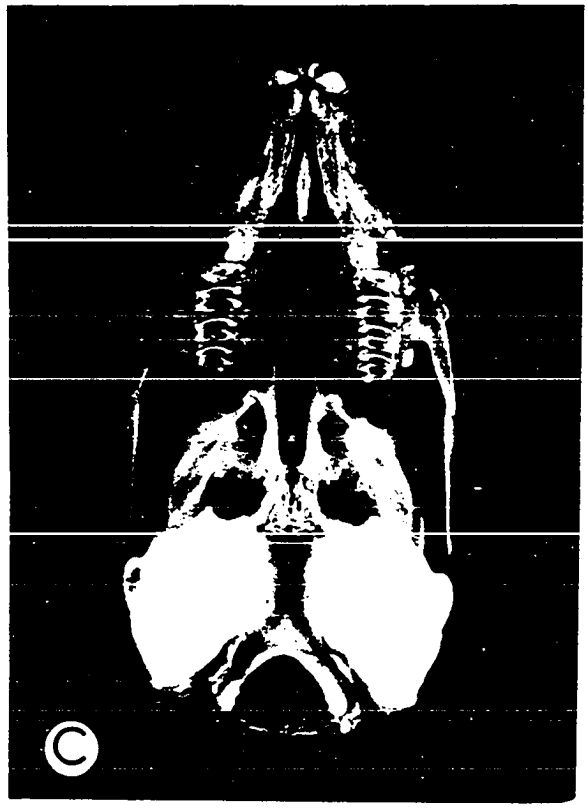
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species and those of the fourth, O. thibetana, from Allen (1938). The cranial measurements for all the species in the curzoniae group are compared in Table 9.

The skull and body measurements of O. sp. are larger than those of O. thibetana. Also the habitat preference differs, with O. sp. occupying the alpine desert biotope of the Mustang District and O. thibetana the moist alpine regions of the eastern Himalayas. The range of O. thibetana extends only into western Sikkim.

Ochotona daurica, a pika also collected from the Mustang District, differs from Ochotona sp. in size (180 to 220 mm), color, skull characters (the dorsal profile of the skull is arched) and habitat preference.

Ochotona roylei, an ochre-colored pika, has smaller auditory bullae (23% or less of the occipitonasal length) than O. sp. (26% or more of the occipitonasal length); the habitat preference of these two species also differs. O. roylei prefers the moist alpine biotopes of eastern and central midlands while O. sp. inhabits the alpine desert biotope of the Tibetan Plateau region.

The large-eared pika (O. macrotis) differs from O. sp. in size, color and cranial measurements. These two species were collected from the same biotope, although O. sp. was taken from flat, open country and O. macrotis from talus slides.

ECTOPARASITES

Siphonaptera:	*Ctenophyllus* n. sp.
	Paradoxopsyllus oribatus
	Rhadinopsylla n. sp.
Ixodoidea:	*Ixodes hyatti*
	I. sp.
Anoplura:	*Hoplopleura ochotonae*

Table 9. Comparison of skull measurements for the curzoniae group of Ochotona (in mm).

	O. daurica (4)	macrotis (1)	roylei (5)	thibetana (6)	sp. (4)
Occipitonasal length	41.5-41.7	44.4	41.7-43.4	34.5-37.0	38.4-39.4
Condylobasal length	38.5-38.8	40.7	40.5-42.8	-	35.5-36.8
Length of nasals	13.3-13.9	15.5	14.3-14.8	-	13.0-13.4
Interorbital constriction	3.2- 3.7	5.2	4.3- 4.8	-	4.4- 4.5
Palatal foramen	12.3-12.6	13.0	12.2-12.5	-	10.2-10.3
Palatal length	13.9-14.1	15.6	14.9-15.3	-	14.4-14.7
Diastema	8.7- 9.2	10.4	9.7-10.0	-	7.6- 7.8
Bulla	10.4-10.9	10.0	9.8- 9.9	-	10.4-10.7
Percentage of bulla to occipitonasal length	22.5-26.1%	22.5%	22.5-23.4%	-	26.4-27.8%
Zygomatic breadth	21.1-21.4	21.6	20.6-21.7	17.2-17.7	18.4-18.5
Upper Tooth row	8.4- 8.2	8.2	7.8- 8.5	6.5- 6.9	7.5- 7.7
Mastoid width	19.4-20.0	21.3	18.5-19.9	15.8-17.5	18.2-18.6

ORDER CETACEA

Platanista gangetica (Lebeck, 1801)

Gangetic Dolphin; Susu, Goonch

1801. Delphinus gangeticus Lebeck. Neue Schr. Ges. Naturf. Fr. Berlin 3: 280.

Type locality: Hooghly River, near Calcutta, India.

1801. Delphinus rostratus Shaw. Gen. Zool. 2(2): 514.

Type locality: Indian Seas.

1817. Delphinus shawensis Blainville. Nouv. Dict. H. N. 9: 153. (renaming of rostratus)

1852. Platanista gangetica Eschricht. Ann. Mag. Nat. Hist. 2(9): 161.

Type locality: Ganges.

1859. Platanista indi Blyth. J. Asiat. Soc. Bengal 28: 493.

1891. Platanista gangetica (Lebeck), in Blanford. The Fauna Brit. India, Mamm. p. 590.

Distribution: India: the Indus, Ganges and Brahmaputra Rivers; Nepal: the major tributaries to the Ganges - Sarda, Karnali, Narayani and Sapt Kosi Rivers.

NEP: 1 sighting: Mitchell - 1.

Habitat: The major rivers of the Terai; especially the Narayani of the Rapti Valley.

Field Notes: In the Gangetic dolphin, the body is fusiform and the head is prolonged into a compressed beak or rostrum which is slightly enlarged distally. The forehead is

wedge-shaped and the lensless eyes are small and degenerate. The slender, compressed beak is armed with a formidable array of teeth; usually 28 or 29 in each side of the upper and lower jaws. There is a low, ridge-like dorsal fin and the broad flippers are cut off squarely at the ends. The blowhole is a longitudinal slit. The color of the back is dark lead gray to lead black; the belly is somewhat lighter. Adults are usually 2 to 3 m long and weigh 220 to 270 kg. Females are generally larger than males.

Gangetic dolphins, found in the larger rivers that drain the Himalayas, enter the larger tributaries to the base of the Siwalik hills. Although several individuals may be seen in the same stretch of river, they are not gregarious. Somewhat migratory, they spend the hot season from March to June in the rivers draining from the Himalayas and the cold months from October to March in the Hooghly River near Calcutta.

These cetaceans are quite blind and probe with their sensitive snouts for fish, shrimp and other fresh water organisms in the bottom mud. After a gestation period of eight to nine months, a single young, very rarely two, is born between April and July. Eschricht (1852) reported that the young dolphin at times holds on to the mother's pectoral fin with its mouth.

On 25 January, 1968, Gangetic dolphins were sighted

in the Narayani River near Bhimliya, Chitwan District. Several were seen in the main stream when they rose to the surface for a few seconds to breathe. One dolphin leaped from the water several times.

The natives of the Rapti Valley net or harpoon these dolphins. They eat the flesh and use the oil for medicine and for burning in lamps.

ECTOPARASITES

None.

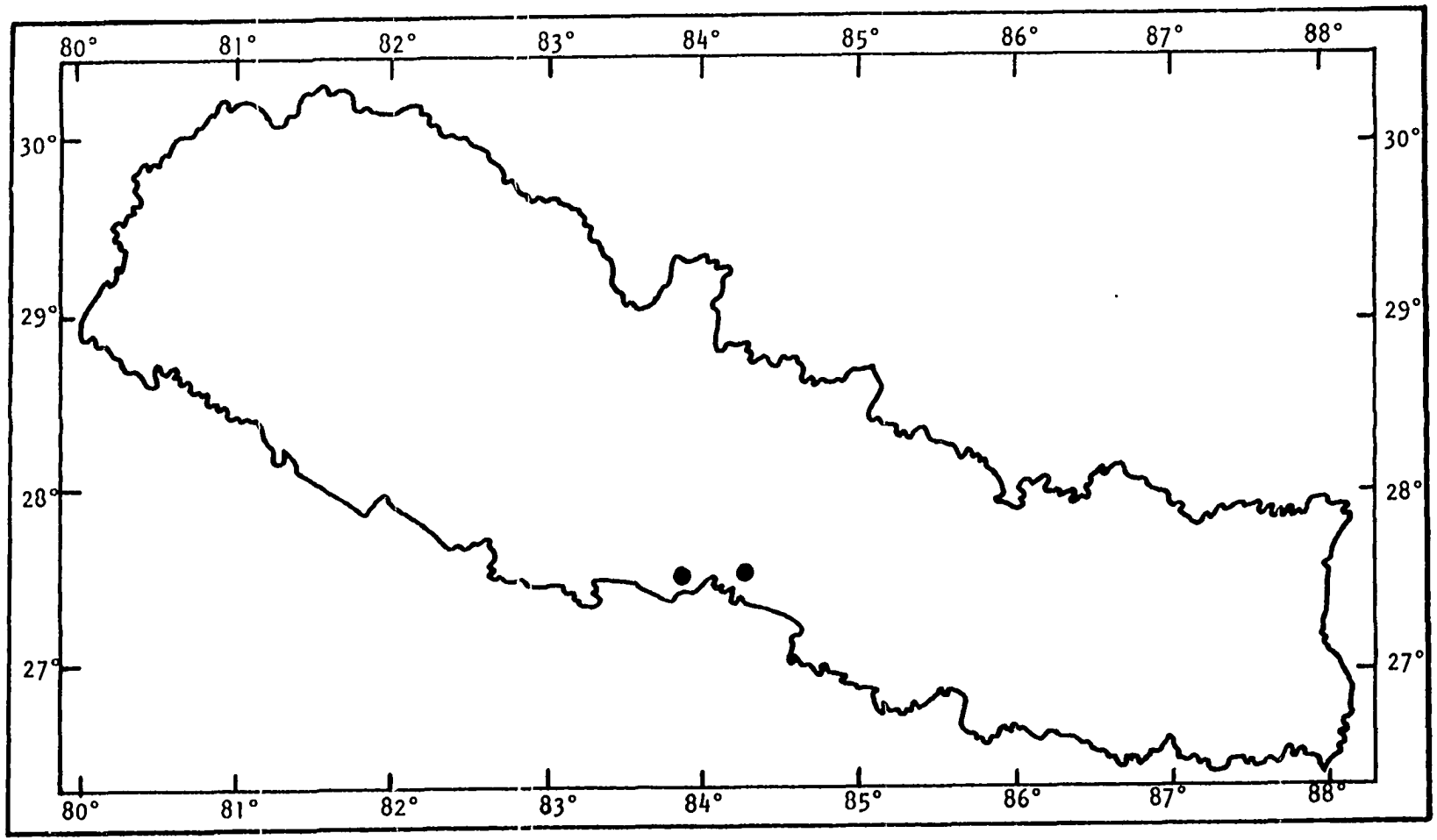


Fig. 31. Sightings for Platanista gangetica

ORDER RODENTIA

Belomys pearsoni pearsoni (Gray, 1842)

Hairy-footed Flying Squirrel

1842. Sciuropterus pearsonii Gray. Ann. Mag. Nat. Hist. 10: 263.

Type locality: Darjeeling, West Bengal, India.

1847. Sciuropterus villosus Blyth. J. Asiat. Soc. Bengal 16: 866.

Type locality: Upper Assam.

1862. Sciuropterus kaleensis Swinhoe. Proc. Zool. Soc. London. p. 359.

Type locality: Northern Formosa.

1879. Pteromys pearsonii Anderson. Anat. and Zool. Researches Western Yunnan. p. 293, pl. 23.

Type locality: Tengyueh, southwestern Yunnan.

1891. Sciuropterus pearsoni Blanford. The Fauna Brit. India, Mamm. p. 369.

1908. Belomys pearsoni Thomas. Ann. Mag. Nat. Hist. 8(1): 2.

Type locality: Manipur, Assam.

Distribution: Northeast Nepal, Darjeeling, Sikkim, Assam, southern China, Taiwan.

NEP: 2 specimens: AVWE - 2.

Habitat: The lower mixed temperate, broadleaved forests (Lithocarpus - Quercus - Michelia and Castanopsis - Quercus) of the eastern midlands, 1500 to 2400 m.

Discussion: Belomys pearsoni is a small flying squirrel with a tail about half the head and body length. The fur is soft and fairly long and long hairs clothe the base of the ears. The feet are covered with long hair which partially conceals the claws.

The color is brown or rufous brown above; the underparts are fulvescent white. The fur on the gliding membrane is black above and ferruginous brown below. The tail is rufous brown, often tipped with black. There are three pairs of mammae. The head and body length is 200 to 260 mm and the length of the tail is 110 to 130 mm.

The dental formula is: i. 1/1; c. 0/0; pm. 2/1; m. 3/3 = 22. The pattern of the molars is essentially the same as in Hylopetes, but the ridges are deeply grooved, wrinkled and excavated (Allen 1940).

This species seems quite rare for very few collection records exist. Little information is available regarding the habits and breeding biology.

Hairy-footed flying squirrels inhabit dense forests of the eastern Himalayas; the AVWE collected the first specimens from Nepal in temperate broadleaved forests between 2100 and 2400 m. In Sikkim, Blanford (1891) reported the occurrence of this species at moderate elevations (900 to 1800 m) in subtropical forests.

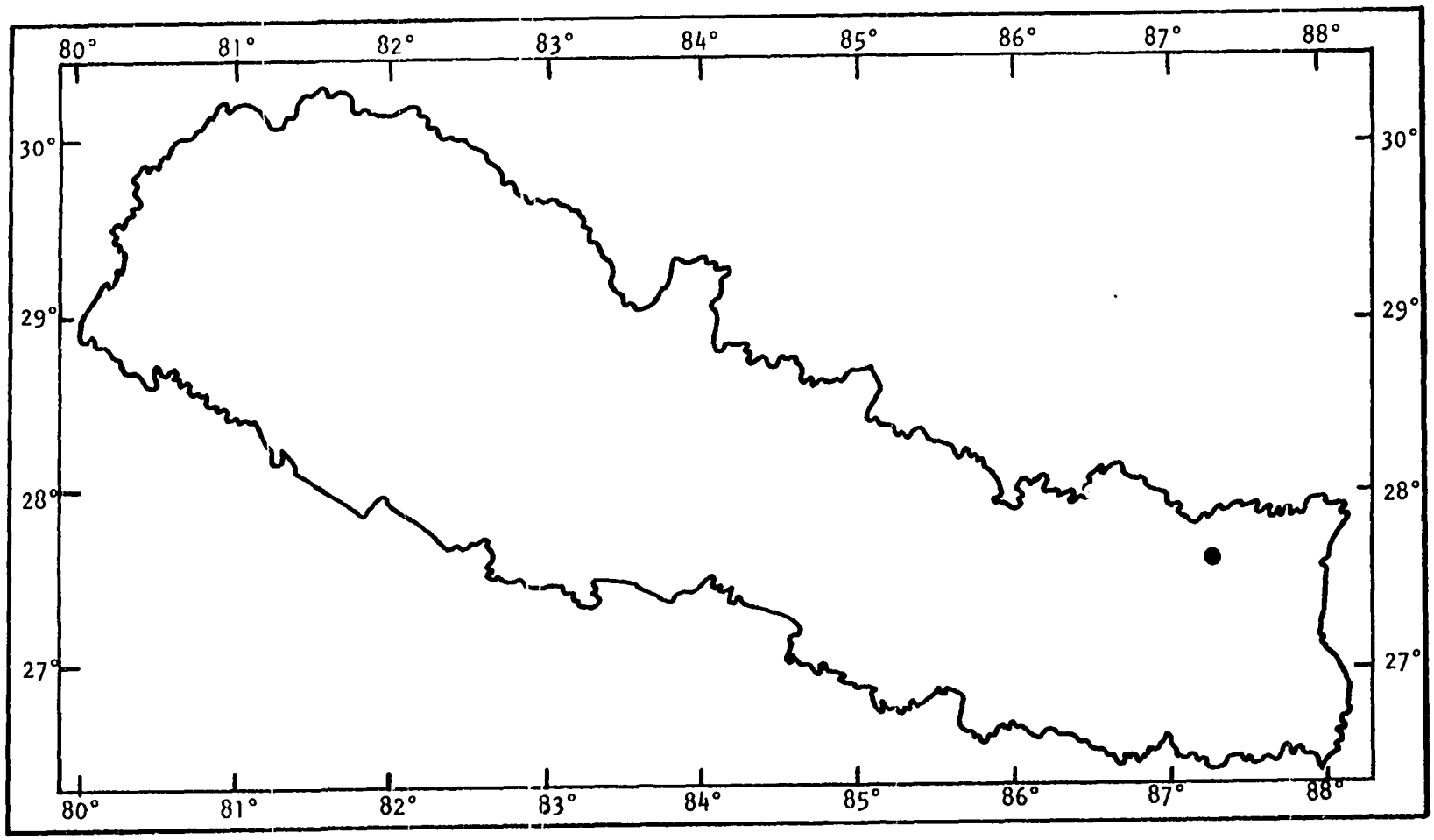


Fig. 32. Collection site for Belomys pearsoni

ECTOPARASITES

Siphonaptera: *Macrostylophora lupata*

Ixodoidea: *Ixodes* sp.
I. sp. A.

Petaurista elegans caniceps (Gray, 1842)

Grayheaded Flying Squirrel

1842. *Sciuropterus caniceps* Gray. Ann. Mag. Nat. Hist. 10: 262.

Type locality: Nepal.

1844. *Sciuropterus senex* Hodgson. J. Asiat. Soc. Bengal 13: 68.

Type locality: Nepal.

1846. *Pteromys caniceps* Gray. Cat. Hodgson's Coll. B. M. p. 21.

Type locality: Nepal.

1911. *Petaurista caniceps* Wroughton. J. Bombay Nat. Hist. Soc. 20(4): 1019.

Type locality: Central region of Nepal.

1947. *Petaurista elegans caniceps* (Gray), in Ellerman. J. Mammal. 28(3): 253.

Petaurista elegans gorkhali (Lindsay, 1929)

1929. *Sciuropterus gorkhali* Lindsay. J. Bombay Nat. Hist. Soc. 33(3): 566.

Type locality: Apoon, Gorkha District, Nepal.

1947. *Petaurista elegans gorkhali* (Lindsay), in Ellerman. J. Mammal. 28(3): 253.

Distribution: Nepal, Darjeeling, Sikkim.

Nepal Records: Hodgson (1844, p. 68), Gray (1846, p. 21), Hinton and Fry (1923, p. 418), Fry (1925, p. 528), Biswas and Khajuria (1957, p. 244).

NEP: 10 specimens: Mitchell - 5; Maser - 4; AVWE - 1.

Habitat: The oak-rhododendron forests of the central midlands from 2100 to 3600 m, temperate and alpine coniferous biotopes of the eastern midlands from 3000 to 3600 m.

Taxonomic notes: Lindsay (1929b) described a new species of Petaurista based upon four specimens from the Gorkha District of Nepal. She contended that the body measurements and skull characters were sufficiently distinct to separate this squirrel from other species of Petaurista, but Ellerman (1947a) considered Sciuropterus gorkhali a subspecies of P. elegans. The body and skull measurements of this species were compared with those of P. e. caniceps (Table 10) and there was little discernible difference between the two species.

Field Notes: This medium sized squirrel, about two-thirds the size of P. magnificus, has large, nearly naked ears and an ash gray or gray speckled head. The color of the dorsal pelage is a uniform rufous brown, and it is ash gray at the base of the fur. The ventral surface is rufous or sometimes a light chestnut. Females have six mammae: one pair pectoral, one abdominal and one inguinal. The number of

teeth is the same as in Belomys, but they differ in structure.

Table 10. Comparison of measurements of Petaurista elegans caniceps with those of P. e. gorkhali (in mm).

	P. e. caniceps	P. e. gorkhali
Total length	657.0 - 668.5 mm	675 - 690 mm
Hind foot	61.1 - 67.4	62 - 64
Occipitonasal length	62.8 - 65.7	61.8 - 63.5
Nasal length	18.7 - 20.2	19.3 - 19.8

These squirrels are strictly arboreal and nocturnal and feed on rhododendron leaves and buds and fir cones. Although pairs were sighted in oak and fir trees 30 to 40 m above the ground, they usually occur singly.

Little information is available regarding their breeding habits. Females usually give birth to one, but sometimes two, young. A lactating female was collected in October. They nest in hollow oak trees or build a nest of ferns in tall rhododendron and fir trees.

These squirrels were located at night by their continuous cry -- a long drawnout scree. When we heard them calling, we flashed on a spotlight and were able to see them without any difficulty, as their eyes shine in the dark. All

specimens were collected with a 12-gauge shotgun. In May of 1967, Maser collected four specimens from Phulung Ghyang, central midlands, and in October, 1969, five additional specimens were taken at Thodung, eastern midlands. In 1973, the AVWE took one specimen from Kasuwa Khola of the Arun Valley. No other species of Petaurista were taken in association with P. e. caniceps.

ECTOPARASITES

Siphonaptera:	Macrostylophora hastata
	Smitipsylla maseri
	S. prodigiosa
Ixodoidea:	Haemaphysalis aponommoides
	Ixodes acutitarsus
Parasitoidea:	Androlaelaps macroventralis
	Eulaelaps stabularis

Petaurista magnificus (Hodgson, 1836)

Hodgson's Flying Squirrel

1836. Sciuropterus magnificus Hodgson. J. Asiat. Soc. Bengal 5: 231.

Type locality: Nepal.

1842. Sciuropterus nobilis Gray. Ann. Mag. Nat. Hist. 10: 263.

Type locality: Darjeeling.

1844. Sciuropterus chrysotrix Hodgson. J. Asiat. Soc. Bengal 13: 67.

1846. Pteromys nobilis Gray. Cat. Hodgson's Coll. B. M. p. 22.

Type locality: Nepal.

1846. Pteromys magnificus Gray. Cat. Hodgson's Coll. B. M. p. 22.

Type locality: Nepal.

1911. Petaurista nobilis Wroughton. J. Bombay Nat. Hist. Soc. 20(4): 1020.

Type locality: Sikkim.

1918. Petaurista magnificus (Hodgson), in Robinson and Kloss. Records Indian Mus. Calcutta 15: 175.

Distribution: Nepal, Darjeeling and Sikkim.

Nepal Records: Hodgson (1836c, p. 231; 1844, p. 67), Gray (1846, p. 22), Hinton and Fry (1923, p. 418), Fry (1925, p. 258), Weigel (1969, p. 150).

NEP: 20 specimens: Mitchell - 15; AVWE - 5.

Habitat: Throughout the oak-rhododendron forests of the midlands from 1800 to 3000 m.

Field Notes: Hodgson's flying squirrel has a bright yellow median line down the middle of the deep maroon pelage. The body is darker than the gliding membrane, the tail is tipped black and the underparts are rufous. This squirrel is about 25% larger than P. e. caniceps. Six mammae are present in the female.

These squirrels are chiefly nocturnal and arboreal, feeding on rhododendron leaves, buds and flowers. In late evening, they begin their call, which is a long drawn-out "Sreee! Sreee!" They build large nests of leaves in oak

trees. The nests consist of ferns and oak leaves with a fine lining of grasses.

The young, usually one or two, are born in February and March. Two females collected in November bore single embryos 22.7 and 22.9 mm in length.

At dusk, flying squirrels were seen gliding a distance of 60 to 100 m from oak to rhododendron trees below. They used their tails as a rudder, and before landing, glided in an upward arc.

In November of 1969, twelve specimens were collected from Kaldapeh, Sindu District. All were taken at night using a spotlight and a 12-gauge shotgun. These squirrels were also sighted in oak forests surrounding the Kathmandu Valley. Four of their nests were collected and checked for ectoparasites.

ECTOPARASITES

Siphonaptera:	*Genoneopsylla longisetosa* *Macrostylophora lupata* *Paraceras sauteri* *Smitipsylla maseri* *S. prodigiosa*
Ixodoidea:	*Ixodes acutitarsus* *I.* sp. *I.* sp. A. *I. kuntzi*
Anoplura:	*Neohaematopinus petauristae*

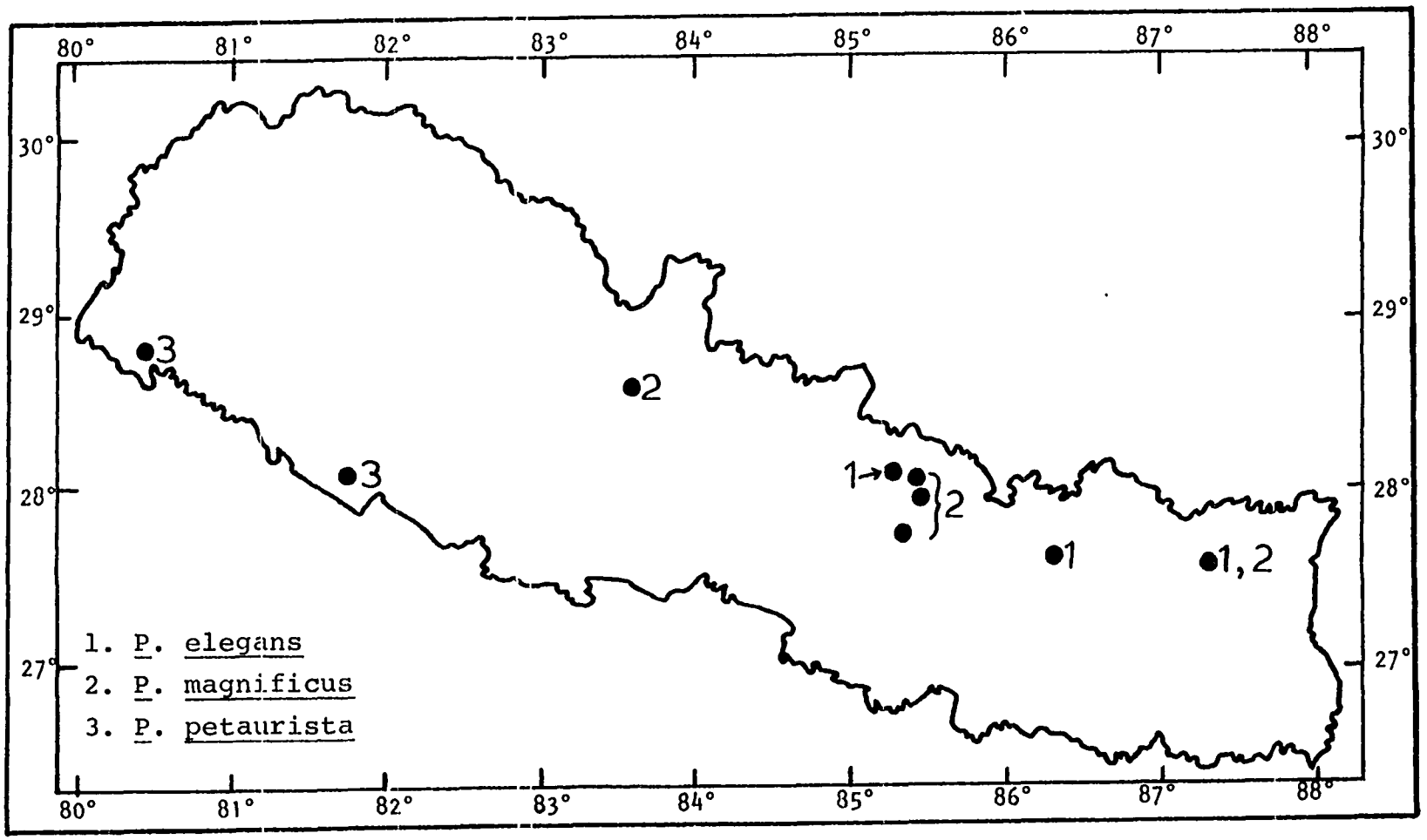


Fig. 33. Collection sites for Petaurista sp.

Petaurista petaurista albiventer (Gray, 1834)

The Large Red Flying Squirrel

1834. Pteromys albiventer Gray. Illus. Ind. Zool. pl. XVIII.

Type locality: Nepal.

1844. Pteromys inornatus Geoffroy, in Jacquemont's Voyage, IV, Mamm. p. 62; Atlas, 2, pl. 4.

Type locality: Northern India.

1911. Petaurista birrelli Wroughton. J. Bombay Nat. Hist. Soc. 20(4): 1019 (new syn.)

Type locality: Murree, Hazara, Punjab.

1911. Petaurista albiventer Wroughton. J. Bombay Nat. Hist. Soc. 20(4): 1020.

Type locality: Nepal.

1911. Petaurista fulvinus Wroughton. J. Bombay Nat. Hist. Soc. 20(4): 1021.

Type locality: Simla, Punjab.

1947. Petaurista petaurista albiventer (Gray), in Ellerman. J. Mammal. 28(3): 255.

Distribution: Punjab, Kumaon, Nepal, probably Kashmir.

Nepal Records: Wroughton (1911, p. 1020), Hinton and Fry (1923, p. 418).

NEP: 2 specimens: Mitchell - 2.

Habitat: Sal forests of the Terai and duns and mixed broadleaved forests of the Siwaliks and Mahabharats, possibly rhododendron forests of the midlands; 100 to 1800 m.

Field Notes: Petaurista petaurista lacks the characteristic color pattern of P. magnificus. This large

squirrel is reddish chestnut overall, the head and back somewhat paler than the bright chestnut gliding membrane. The fur is always grizzled with profuse, white-tipped hairs. The size and cranial features of this species are similar to those of P. magnificus. The body measurements of two specimens are: TL: 863.6 and 878.1 mm, T: 495.0 and 499.6 mm, HF: 76.2 and 77.1 mm and E: 35.0 and 37.1 mm.

This species is nocturnal and arboreal and the diet consists of the buds, flowers and fruits of deciduous trees. Little is known about the breeding biology, but Blanford (1891) reported that females give birth to one and sometimes two young.

On 10 February, 1970, this flying squirrel was sighted near Dhangarhi, Kailali District (far western Terai). Skins of two specimens were also seen at Gulari, Banke District. On 29 March, 1970, a male and female were shot near Mahendranagar, Banke District. All of the above locations are between 120 and 220 m; but according to Walker et al. (1964b), members of this genus are only found above 900 m.

ECTOPARASITES

None.

Hylopetes alboniger alboniger (Hodgson, 1836)

Particolored Flying Squirrel

1836. Sciuropterus alboniger Hodgson. J. Asiat. Soc. Bengal 5: 231.

Type locality: Nepal.

1837. Sciuroptera turnbulli Gray. Proc. Zool. Soc. London. p. 68.

Type locality: India.

1837. Pteromys leachii Gray. Charlesw. Mag. Nat. Hist. 1: 584.

1879. Pteromys alboniger Anderson. Anat. and Zool. Researches Western Yunnan. p. 298.

Type locality: Tengyueh, Yunnan, China.

1923. Hylopetes alboniger Thomas. Ann. Mag. Nat. Hist. 2 (Ser. 9): 658.

Type locality: Likiang Range, Yunnan.

1925. Pteromys (Hylopetes) alboniger Allen. Amer. Mus. Novitates No. 163, p. 15.

Type locality: Yunnan.

1940. Pteromys (Hylopetes) alboniger orinus Allen. The Mamm. China and Mongolia Nat. Hist. Cent. Asia. Vol. 11, Part 2, p. 723.

Type locality: Likiang Range, Yunnan, China.

Distribution: Yunnan, Burma, Assam, Bhutan Duars, Sikkim, Darjeeling, Nepal.

Nepal Records: Hodgson (1836c, p. 231), Gray (1846, p. 22), Hinton and Fry (1923, p. 418).

NEP: 4 specimens: Mitchell - 4.

Habitat: The oak-rhododendron forests of the midlands from 1500 to 2800 m.

Taxonomic Notes: Hodgson (1836c) originally placed

this group of squirrels in the genus Sciuropterus, but subsequently this species was reassigned to the genus Pteromys. In 1908, Thomas subdivided the genus Pteromys into four subgenera, but later (1923a) elevated Hylopetes to generic rank.

Field Notes: Hylopetes is much smaller than Petaurista. The fur is soft, dense and moderately long. The color of the upper parts ranges from grayish brown to rufous brown and the undercoat is ashy or black. The venter is white with the undercoat dark gray at the base. The feet and tail are brown.

These squirrels are arboreal and nocturnal; they nest in hollow trees. At night their presence can be detected by a high-pitched trill or a repeated scree. Their food consists of fruits, nuts, leaves, and buds. The breeding season runs from April through mid-June and there are two to three young born each litter.

Five specimens were collected from the oak-rhododendron forests of Kaldapeh, Sindu District. Hylopetes and Petaurista were equally abundant in these forests and neither showed any differentiation in niche preference. On 29 April, 1970, a female and two young were captured from a nest in a hollow oak tree. The nest, consisting of a ball of oak leaves and ferns lined with fine grasses, was located about 10 m above the ground.

ECTOPARASITES

Siphonaptera: Macrostylophora lupata

Anoplura: Neohaematopinus sp.

Callosciurus pygerythrus lokroides (Hodgson, 1836)

The Hoary-bellied Himalayan Squirrel

1836. Sciurus lokroides Hodgson. J. Asiat. Soc. Bengal 5: 232.

Type locality: Nepal.

1843. Sciurus assamensis Gray, in M'Clelland. List. Spec. Mamm. Brit. Mus. p. 143. (nom. nud.)

1867. Macroxus similis Gray. Ann. Mag. Nat. Hist. 20: 281.

Type locality: Sikkim.

1915. Tomeutes lokroides (Hodgson), in Thomas. Ann. Mag. Nat. Hist. 158: 386.

1940. Callosciurus lokroides lokroides (Hodgson), in Ellerman. Families and Genera Living Rodents. Vol. 1, p. 273.

1961. Callosciurus pygerythrus lokroides (Hodgson), in Ellerman. Fauna of India, Rodentia. Vol. 3, part 1, p. 168.

Distribution: The eastern Himalayas: Nepal, Sikkim, Bhutan Duars.

Nepal Records: Hodgson (1836c, p. 232), Gray (1846, p. 23), Hinton and Fry (1923, p. 419), Fry (1925, p. 528), Weigel (1969, p. 150), Chesemore (1970, p. 164), Abe (1971, p. 407).

NEP: 19 specimens: Maser - 17; AVWE - 2.

Habitat: The mixed forest zone of the eastern Siwaliks and Mahabharat Range, from 400 to 2300 m.

Field Notes: These squirrels are brilliantly colored: speckled olive brown to gray dorsally and light rufous or buff ventrally. The tail is olive brown with the hairs annulated to form alternating bands of black and white. Females have four mammae. The length of the head and body is 175 to 280 mm; the tail is usually 150 to 260 mm in length.

According to Allen (1940), the skull characters of this group do not differ essentially from those of Sciurus. The teeth are the same in number and structure, but are smaller in size. The brain case is slightly less full and globular and the frontal area is more depressed.

These squirrels are found throughout the eastern half of the Himalayan foothills in mixed broadleaved forests. The northern part of their range overlaps with that of the orange-bellied Himalayan squirrel (Dremomys lokriah).

The habits of these squirrels are similar to those of Ratufa. Diurnal and mainly arboreal, they feed on seeds, nuts, fruits, buds and flowers. The stomach contents of a specimen collected by Abe (1971) contained ants (5%), lepidopteran larvae (35%) and fruits (60%). They live in hollow trees, but also build nests of sticks and leaves. The gestation period is not known. The number of young in a litter is usually three or four (Walker et al. 1964b).

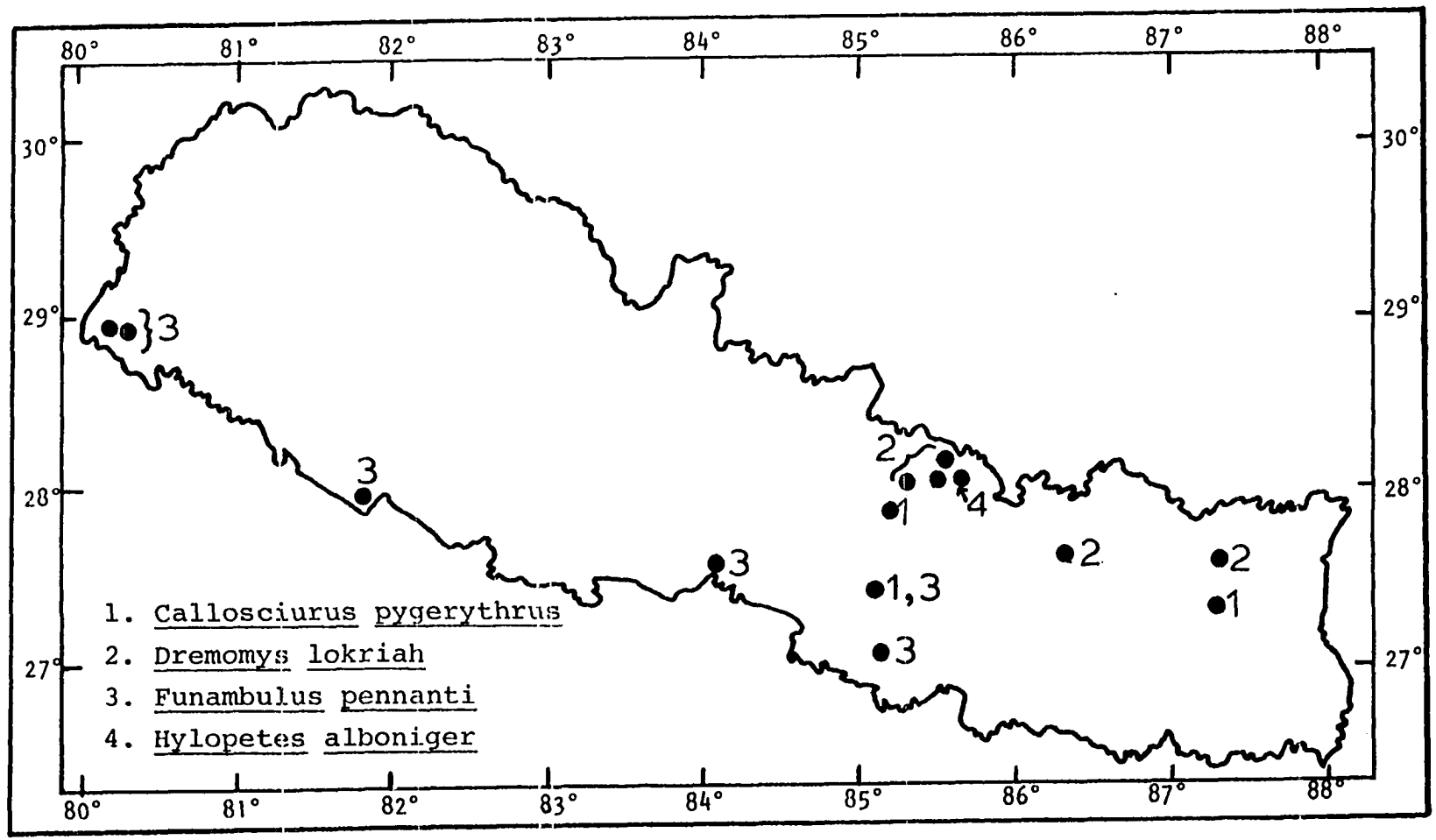


Fig. 34. Collection sites for other Sciuridae

ECTOPARASITES

Siphonaptera:	Macrostylophora hastata
	M. lupata
Ixodoidea:	Dermacentor auratus
Parasitoidea:	Androlaelaps traubi
	Haemolaelaps traubi
Anoplura:	Hoplopleura erismata

Callosciurus macclellandi macclellandi (Horsfield, 1839)

Himalayan Striped Squirrel

1839. Sciurus macclellandi Horsfield. Proc. Zool. Soc. London. p. 152.

Type locality: Assam.

1842. Sciurus pembertonii Blyth. J. Asiat. Soc. Bengal 11: 887.

Type locality: Bhutan.

1900. Sciurus macclellandi manipurensis Bonhote. Ann. Mag. Nat. Hist. 5: 51.

Type locality: Aimole, Manipur.

1906. Tamiops macclellandi macclellandi (Horsfield), in Allen. Bull. Amer. Mus. Nat. Hist. 12: 475.

1940. Callosciurus macclellandii macclellandii (Horsfield), in Ellerman. Families and Genera Living Rodents. Vol. 1, p. 354.

1961. Callosciurus macclellandi macclellandi (Horsfield), in Ellerman. Fauna of India, Rodentia. Vol. 3, part 1, p. 95.

Distribution: Manipur, Assam, Burma, Bhutan, Sikkim.

Habitat: The dense broadleaf forests of the eastern Himalayas from 1500 to 2000 m.

Discussion: The upper parts of this squirrel are colored a dull grayish brown with a well-defined black stripe down the middle of the back. A broad, pale buff or whitish band extends from the muzzle down each side of the head, neck and body. The lower parts vary from whitish or pale brown to buff or pale rufous. Rufous, whitish and black rings alternate on the tail. The ears are covered with long hair that forms a long white pencil. The length of the head and body is 115 to 150 mm. Three pairs of mammae are present (Blanford 1891).

Little is known about the biology and habits of this squirrel; but according to Blanford (1891), it is arboreal, rarely descending to the ground.

Ellerman and Morrison-Scott (1966) show the range of this species extending westward to Nepal. As yet, the striped Himalayan squirrel has not been collected from the country. Ellerman (1961a) reported collections from Sikkim, the Mishmi and Naga Hills, Assam and Burma.

Dremomys lokriah (Hodgson, 1836)

Orange-bellied Himalayan Squirrel

1836. Sciurus lokriah Hodgson. J. Asiat. Soc. Bengal 5: 232.

Type locality: Nepal.

1843. Sciurus subflaviventris Gray. Handlist Mamm. B. M. p. 144. (nom. nud.)

Type locality: Assam.

1846. Sciurus locria Gray. Cat. Hodgson's Coll. B. M. p. 23.

Type locality: Nepal, Central Region.

1916. Dremomys lokriah bhotia Wroughton. J. Bombay Nat. Hist. Soc. 24(3): 418-426.

Type locality: Sedonchen, Sikkim.

1922. Dremomys lokriah subflaviventris Thomas. J. Bombay Nat. Hist. Soc. 28(2): 429.

Type locality: Mishmi, Assam.

1940. Dremomys lokriah lokriah (Hodgson), in Ellerman. Families and Genera Living Rodents. Vol. 1, p. 381.

Distribution: Nepal, Darjeeling, Sikkim, Mishmi, Assam, to northern Burma.

Nepal Records: Hodgson (1836c, p. 232), Gray (1846, p. 23), Scully (1879, p. 366), Hinton and Fry (1923, p. 419), Fry (1925, p. 528), Worth and Shah (1969, p. 127), Weigel (1969, p. 150), Abe (1971, p. 407).

NEP: 28 specimens: Mitchell - 26; Maser - 1; AVWE - 1.

Habitat: Oak-rhododendron forests of the central and subtropical forests of the eastern midlands, 1000 to 2700 m.

Taxonomic Notes: Dremomys is not a well-defined genus; it is closely related to Callosciurus. According to Ellerman (1940), "Its chief, and indeed only character of generic value, is a tendency to lengthening of the rostrum." Thomas (1915) pointed out that the characters of the baculum

of Dremomys are very different from those of Callosciurus.

Field Notes: The orange-bellied Himalayan squirrel is dark, olive brown above and bright orange on the venter and thighs. The bicolored tail is olive brown dorsally and ferruginous ventrally. The tail is shorter than the head and body and the snout is elongate and narrow. There are three pairs of mammae, one pectoral and two inguinal.

The nasals are normally longer than the frontals, probably on account of the lengthening of the rostrum. The dental formula is the same as Sciurus and Callosciurus (i. 1/1; c. 0/0; pm. 2/1; m. 3/3 = 22).

Orange-bellied squirrels are found only in the central and eastern midlands; none were sighted or collected west of 84^{o} 30' E longitude. They are strictly diurnal and nest in hollow trees. The nest consists of ferns and oak leaves with a lining of fine grasses. They frequently come to the ground to search for fruits, nuts and plant materials. In the eastern Himalayas, individuals were seen feeding on the fruits of Pandanus furcatus. Abe (1971) also listed insects as an important part of their diet. The call is a sharp, squeaky chatter which is repeated often.

Young are born from May through August in litters of two to five. A female taken on 10 August, 1968, bore four embryos. Lactating females were collected in May, June and August.

ECTOPARASITES

Siphonaptera:	Dasypsyllus gallinulae
	Macrostylophora lupata
	Rowleyella arborea
	Smitipsylla maseri
Ixodoidea:	Haemaphysalis montgomeryi
	Ixodes sp.
Parasitoidea:	Eulaelaps stabularis
Anoplura:	Neohaematopinus elbeli

Funambulus pennanti pennanti Wroughton, 1905

Northern Palm Squirrel

1905. Funambulus pennantii Wroughton. J. Bombay Nat. Hist. Soc. 16(3): 411.

Type locality: Mandvi Taluka, Surat District, Bombay Presidency, India.

1905. Funambulus pennantii argentescens Wroughton. J. Bombay Nat. Hist. Soc. 16(3): 413.

Type locality: Rawalpindi, Northern Punjab.

1916. Funambulus pennantii lutescens Wroughton. J. Bombay Nat. Hist. Soc. 24: 430.

Type locality: Deesa, Palanpur, India.

Distribution: From the base of the Himalayas throughout peninsular India, into West Pakistan.

Nepal Records: Hinton and Fry (1923, p. 419), Worth and Shah (1969, p. 127), Chesemore (1970, p. 164), Abe (1971, p. 406).

NEP: 16 specimens: Mitchell - 15; Maser - 1.

Habitat: The mixed broadleaved forests of the Terai, duns and Siwaliks, near towns and villages, 100 to 600 m.

Field Notes: The northern palm squirrel is distinct in having five pale stripes on the back and three median dorsal stripes flanked on each side by a supplementary pale stripe. The underparts are white or whitish gray and the tail hoary, flecked with black. Two pairs of mammae are present.

Palm squirrels are common throughout the sal forests of the Terai and foothills. They are gregarious and as many as nine individuals have been sighted in a single tree. Their particularly shrill, bird-like call is repeated over and over. Diurnal, they forage actively on the ground and in trees for seeds, nuts, buds, flowers and young stems. According to Prater (1965), they also feed on nectar, insects and bird eggs. Abe (1971) found that large amounts of dipteran and coleopteran larvae were consumed by these squirrels.

The gestation period is 40 to 45 days and two to four young are born from May through July (Walker et al. 1964b). Females build a globular nest of plant material in which the young are born and reared (Prater 1965). Specimens collected between December and April were not reproductively active.

ECTOPARASITES

Ixodoidea: Argas sp. 2
Haemaphysalis bispinosa

H. canestrinii
H. montgomeryi

Parasitoidea: Haemolaelaps traubi
Liponyssoides muris

Mallophaga: Bruelia salienii salienii
Colinicola meinertzhagani

Anoplura: Enderleineleus nishimauri
Hoplopleura moniculata
Neohaematopinus echinatus

Ratufa bicolor gigantea (M'Clelland, 1839)

Assam Giant Squirrel

1839. Sciurus giganteus M'Clelland. Proc. Zool. Soc. London. p. 150.

Type locality: Upper Assam.

1842. Sciurus macruroides Hodgson. J. Nat. Hist. Calcutta p. 220.

Type locality: Nepal.

1891. Sciurus bicolor Blanford. The Fauna Brit. India, Mamm. p. 373.

1916. Ratufa giganteus lutrina Thomas and Wroughton. J. Bombay Nat. Hist. Soc. 24: 226.

1918. Ratufa gigantea gigantea Robinson and Kloss. Records Indian Mus. 15: 192.

1923. Ratufa gigantea stigmosa Thomas. J. Bombay Nat. Hist. Soc. 29(1): 86.

Type locality: Doi Sritepe, Chiengmai, Siam.

1947. Ratufa bicolor gigantea (M'Clelland), in Ellerman. J. Mammal. 28(3): 260.

Distribution: Nepal, Sikkim, Assam, Burma, Thailand.

Nepal Records: Hodgson (1842a, p. 220), Gray (1846, p. 22).

NEP: 2 specimens (from Darjeeling, West Bengal, India): Mitchell - 2.

Habitat: The lower regions and deep valleys of the Siwaliks and Mahabharat Range from 500 to 2000 m and the subtropical and temperate deciduous forests of the eastern regions.

Field Notes: These squirrels are large with the tail nearly equal to the head and body length. The dorsal surface of the body, the outer parts of the limbs, and the tail are black or brownish black, the underparts buffy white to yellow. The dark brownish black of the face extends around the eyes and ears. The ears are short, round and tufted. The feet are broad, the claws large and powerful. Six inguinal mammae are present. The head and body length is 300 to 460 mm, the tail length 250 to 400 mm and the weight 1.5 to 3 kg.

The skull is heavy with a short, broad rostrum. The postorbital processes are very large and triangular. The dental formula is: i. 1/1; c. 0/0; pm. 1/1; m. 3/3 = 20 (Allen 1940).

Assam giant squirrels are native to the tropical forests of the eastern Himalayas. They are arboreal and diurnal in habits and extremely agile, making leaps of 5 meters or more from tree to tree. Walker et al. (1964b) listed their diet as fruit, nuts, tree bark, insects and

bird eggs. Usually these squirrels are solitary, but sometimes they associates in pairs. Their call is a loud, harsh cackle.

Blanford (1891) reported a gestation period of 28 days for Ratufa macroura. In R. bicolor, there are several litters of one to two young each year (Walker et al. 1964b). The young are born and raised in large globular nests of twigs and leaves.

Hodgson (1842a) collected this species from Nepal, reporting the lower regions and deep valleys of central Nepal as its habitat. Nadchatram, with the Nepal Medical Survey, shot a specimen from the Ilam District, but was unable to retrieve it. Local people have reported the occurrence of this squirrel in the Morang District. Two specimens were collected by the NEP from Badamtam Tea Estate, Darjeeling (1000 m), and several other individuals were sighted. In December their large, globular nests were quite conspicuous in the deciduous forests of the Darjeeling area.

ECTOPARASITES

Ixodoidea: Dermacentor auratus
Haemaphysalis sp.

Marmota bobak himalayana (Hodgson, 1841)

Bobak Marmot (Himalayan Marmot)

1841. Arctomys himalayanus Hodgson. J. Asiat. Soc. Bengal 10: 777.

Type locality: Nepal.

1843. Arctomys hemachalanus Hodgson. J. Asiat. Soc. Bengal 12: 410.

Type locality: Nepal.

1846. Arctomys tibetanus Gray. Cat. Hodgson's Coll. B. M. p. 24.

1847. Arctomys bobac Blyth. J. Asiat. Soc. Bengal 16: 875.

1847. Arctomys tataricus Jameson. L'Institut 15: 384.

1872. Arctomys robustus Milne-Edwards. Nouv. Arch. Mus. Bull. 7: 92.

Type locality: Moupin, Szechuan, China.

1879. Arctomys hodgsoni Blanford. Yarkand Miss. Mamm. p. 35.

Type locality: Nepal.

1923. Marmota himalayanus Hinton and Fry. J. Bombay Nat. Hist. Soc. 29(2): 419.

Type locality: Northern region of Nepal.

1940. Marmota himalayana himalayana Ellerman. Families and Genera of Living Rodents. Vol. 1, p. 460.

Type locality: Nepal.

1947. Marmota bobak himalayana (Hodgson), in Ellerman. J. Mammal. 28(3): 258.

Distribution: Szechuan, Sikkim, Northern Nepal, Tibet.

Nepal Records: Hodgson (1841d, p. 777; 1843a, p. 410),

Gray (1846, p. 24), Hinton and Fry (1923, p. 419).

Habitat: The arid northern regions of the Himalayas and the Tibetan steppe biotope of the Mustang District, 4000 to 5500 m.

Discussion: The Himalayan marmot is a stout bodied, badger-shaped animal with short, rounded ears, a short and slightly flattened tail and strong feet with stout claws for digging. The body and limbs are pale tawny mixed with black on the upper parts. The face and terminal third of the tail are dark brown and the cheeks are rufous. There are six pairs of mammae (Blanford 1891). The head and body length is 260 to 350 mm, the tail length 120 to 155 mm.

The skull is heavily built and triangular in outline. The postorbital processes are strong and nearly transverse. The dental formula is: i. 1/1; c. 0/0; pm. 2/1; m. 3/3 = 22.

Himalayan marmots are essentially boreal, inhabiting open and rocky places. They live in large colonies and excavate deep burrows in which they hibernate through the winter. Their food consists of roots, leaves, grasses and seeds of various plants. Mating takes place in early spring and the gestation period is 35 to 42 days. Young are born in litters of two to nine from April to July (Walker et al. 1964b).

Hodgson (1841d, 1843a) and Gray (1846) recorded the Himalayan Marmot as occupying the northern regions of Nepal and Tibet. In March, natives of the Mustang District said that

marmots do live in the area, but that they were still in hibernation.

Hystrix hodgsoni hodgsoni (Gray, 1847)

Crestless Himalayan Porcupine

1847. Acanthion hodgsoni Gray. Proc. Zool. Soc. London. p. 101.

Type locality: Nepal.

1847. Hystrix alophus Hodgson. J. Asiat. Soc. Bengal 16: 771.

Type locality: Himalayas.

1851. Hystrix bengalensis Blyth. J. Asiat. Soc. Bengal 20: 170.

Type locality: Bengal.

1891. Hystrix hodgsoni Blanford. The Fauna Brit. India, Mamm. p. 444.

Distribution: The Himalayas: Nepal, Sikkim, Naga Hills of Assam.

Nepal Records: Gray (1847, p. 101), Hodgson (1847d, p. 771), Hinton and Fry (1923, p. 423).

Habitat: The lower slopes of the Himalayas in brushy areas overgrown with bamboo and scrub, from 1000 to 2500 m.

Field Notes: The crestless porcupine is stout-bodied with a short tail and lacks a crest of spines on the head, neck or shoulders. The color is dark blackish brown with a white half-collar on the throat formed by short, white spines.

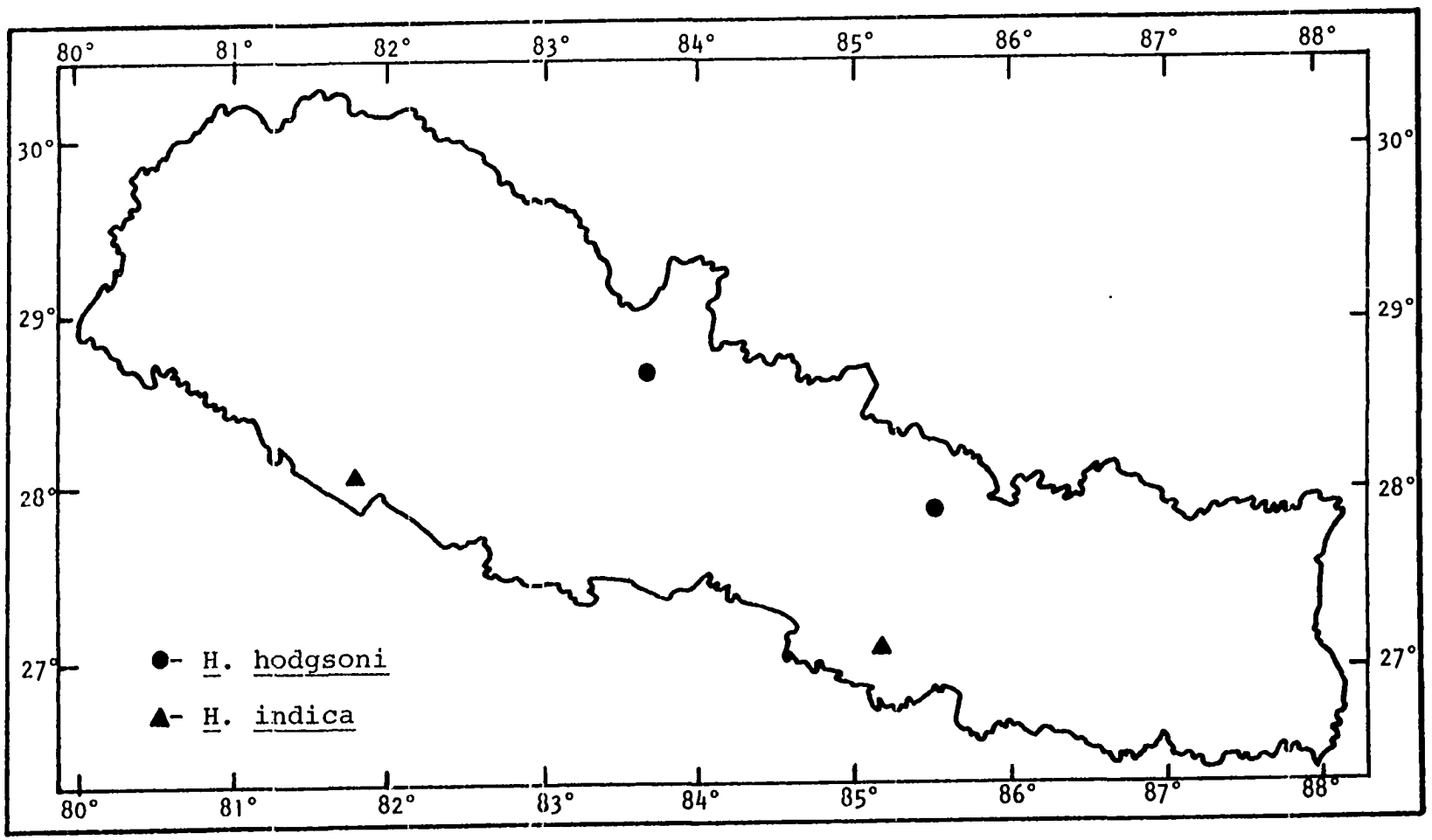


Fig. 35. Sightings for Hystrix sp.

The crest on the back consists of elongated slender bristles which are dark brown at the base and white for the distal two-thirds. The length of the head and body is 550 to 670 mm, the length of the tail about 100 to 125 mm. The number of mammae is six.

According to Blanford (1891), these porcupines are monogamous and live in burrows. They are nocturnal and their diet consists of fruit, bark, roots, potatoes and other succulent vegetation. They breed in the spring and usually have two young. Walker et al. (1964b) reported a gestation period of about 112 days, with two litters a year common.

In the Pokhara area, porcupines frequently destroy the potato crops. Traps were set in and around the potato fields, but no specimens were caught. They are considered a delicacy, and I encountered the remains of one eaten by the local people.

Hystrix indica Kerr, 1792

Indian Crested Porcupine

1792. Hystrix cristata var. indica Kerr. Anim. Kingd. 213. (Based on Smellie's Buffon, 1781, 7: pl. 206).

Type locality: India.

1831. Hystrix leucurus Sykes. Proc. Zool. Soc. London. p. 103.

Type locality: Deccan, India.

1851. Hystrix zeylonensis Blyth. J. Asiat. Soc. Bengal 20: 171.

Type locality: Ceylon.

1865. Hystrix malabarica Sclater. Proc. Zool. Soc. London. p. 353.

Type locality: Cochin, Southern India.

1867. Hystrix leucura Jerdon. The Mamm. of India. p. 218.

1911. Hystrix hirsutirostris blanfordi Müller. S. B. Ges. Nat. Fr. Berlin. p. 121.

Type locality: Jalk, Baluchistan.

1911. Hystrix hirsutirostris mersinae Müller. S. B. Ges. Nat. Fr. Berlin. P. 122.

Type locality: Mersina, southeast of Taurus, Asia Minor.

1911. Hystrix hirsutirostris aharonii Müller. S. B. Ges. Nat. Fr. Berlin. p. 123.

Type locality: Emmaus, west of Jerusalem, Palestine.

1911. Hystrix hirsutirostris schmidtzi Müller. S. B. Ges. Nat. Fr. Berlin. p. 126.

Type locality: Ain Dcheier, Jordan Valley, Palestine.

1912. Hystrix cuneiceps Wroughton. J. Bombay Nat. Hist. Soc. 21: 771.

Type locality: Nokania, Cutch, India.

1919. Hystrix narynensis Müller. S. B. Gest. Nat. Fr. Berlin. p. 67.

Type locality: Region between Lake Issyl Kul and River Naryn, north of Tianshan, Russian Turkestan.

1920. Hystrix mesopotamica Müller. Zool. Anz. 51: 198.

Type locality: Jebel Abdul Azir, northeastern Syria.

Distribution: Nepal Terai, Peninsular India and Sri Lanka, Baluchistan, Middle East, Asia Minor, Russian Turkestan.

Nepal Records: Hodgson (1834b, p. 96), Gray (1846, p. 20), Hinton and Fry (1923, p. 423), Chesemore (1970, p. 164).

NEP: 2 sightings: Mitchell - 2.

Habitat: The mixed forest zone and scrub jungle of the Terai and the rocky foothills of the Siwaliks.

Field Notes: The Indian porcupine is larger than H. hodgsoni and has a well-developed crest of bristles 150 to 300 mm long on the nape and shoulders. The muzzle is densely clad with hair and the foreparts of the body, limbs and abdomen are covered with short spines intermingled with hair. The flanks, rump and tail are covered with long spines. The head and body length is 600 to 800 mm, the tail 100 to 250 mm in length and the weight 10 to 18 kg. Three pairs of pectoral mammae, laterally situated, are present. The skull is moderately convex above with the nasals nearly twice the length of the frontals.

Crested porcupines are active at night and during the day remain in caves, among boulders or in burrows. They feed on roots, vegetables and fruits and are quite destructive to field crops. When irritated they utter a grunting sound and produce a peculiar rattling noise with their quills. One to four young are born, usually in March, after a gestation period of about 112 days (Walker et al. 1964b).

In December of 1967 an Indian porcupine was sighted near Madhuban, Bara District, and in 1968 another was seen at Gulari, Banke District. The agility of porcupines trying to

elude capture is surprising. Both porcupines were able to avoid capture by outrunning our jeep.

Cannomys badius badius (Hodgson, 1842)

Bay Bamboo Rat, Lesser Bamboo Rat

1842. Rhizomys badius Hodgson. J. Nat. Hist. Calcutta 2: 60, 410.

Type locality: Nepal Terai.

1915. Cannomys badius (Hodgson), in Thomas. Ann. Mag. Nat. Hist. 16: 57.

Distribution: Nepal Terai, probably the Darjeeling District of India, Bhutan Duars.

Nepal Records: Hodgson (1842e, p. 60), Gray (1846, p. 24), Hinton and Fry (1923, p. 423), Chesemore (1970, p. 164).

NEP: 5 specimens: Maser - 3; Mitchell - 2.

Habitat: The eastern Terai and Rapti Dun to the base of the Himalayas, in alluvial soils of mixed forests; 100 to 400 m.

Field Notes: Bamboo rats are medium-sized rodents which are specialized for subterranean life. They are included in a separate family of rodents, the Rhizomyidae, which contains two genera, Rhizomys and Cannomys. Except for their large projecting incisors, they resemble gigantic moles. The eyes and ears are small, the limbs short and armed with large, strong claws, the body cylindrical and the tail vestigial.

The fur is soft and rather thick and the ears are hidden by the fur. The pelage is chestnut, bay or ashy brown above, the lower parts paler. Sometimes there is a white spot on the forehead. The mammae are eight in number: one pair pectoral and three abdominal.

The skull is modified for subterranean life. The incisors are very broad and heavy, pigmented orange. The infraorbital foramen is open and the zygomatic plate is tilted upwards. There is a total of 16 teeth and the cheekteeth are flat-crowned (Ellerman 1940).

These rodents live in burrows which they excavate with their teeth and claws, burrowing in banks and alluvial soils beneath tree roots. Mounds of freshly excavated dirt are piled at the burrow entrances. Several authors (Blanford 1891; Prater 1965; Walker et al. 1964b) claim that bamboo rats leave their burrow at night to feed on plant materials. Their food consists of grass stems, bamboo shoots and roots. Little is known about their breeding habits. Blanford (1891) reported that females give birth to three or four young each litter and Allen (1940) collected very young specimens in June, July and November in China.

Bamboo rats were trapped by removing the dirt plug of the burrow entrance and placing a #4 gopher trap 40 to 60 cm back in the main tunnel. Since they push dirt from their burrows with their posterior ends, the two specimens were

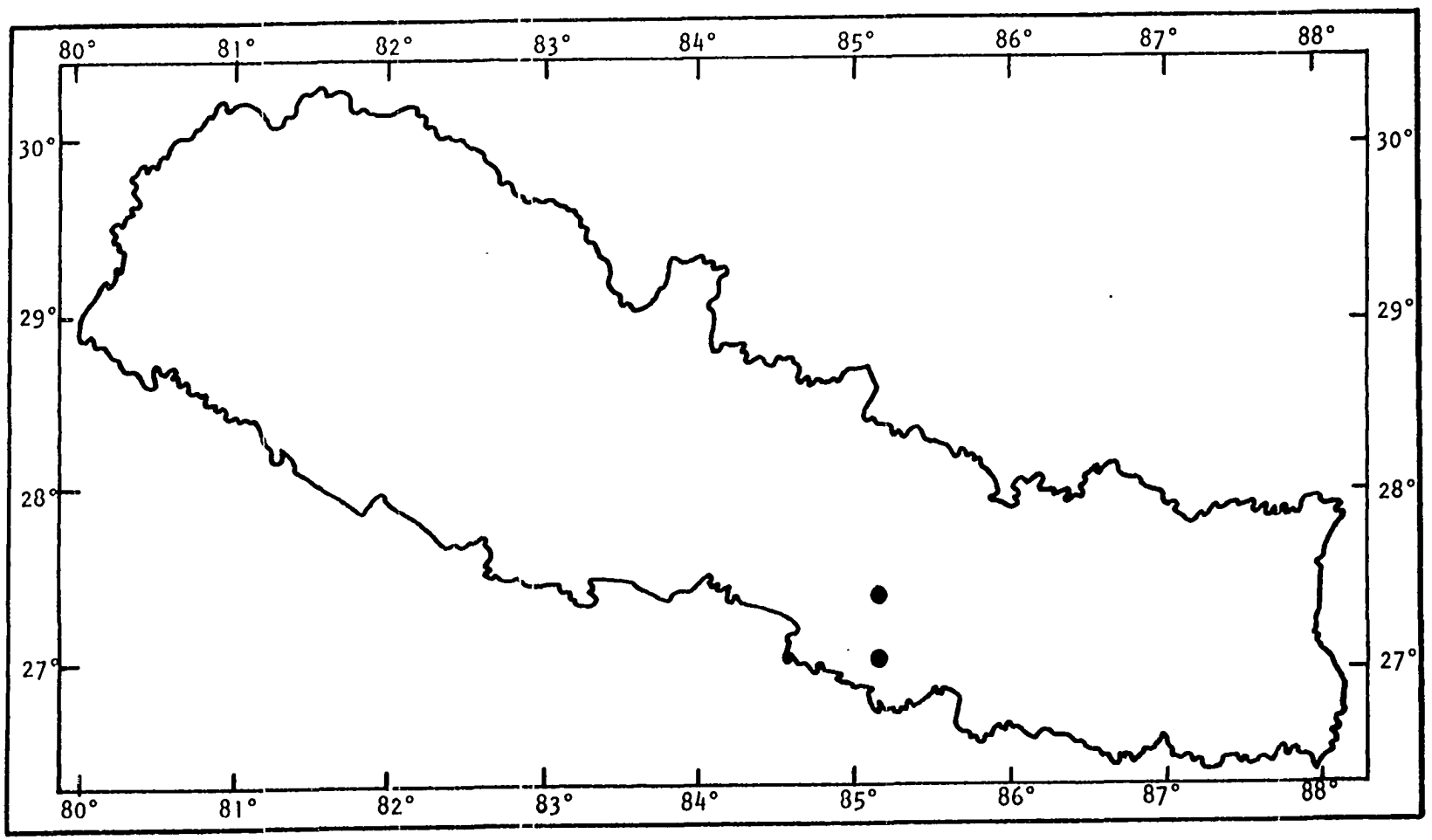


Fig. 36. Collection sites for Cannomys badius

caught by the hind portion of the body.

ECTOPARASITES

Parasitoidea: Hypoaspis lubrica
Rhyzolaelaps inaequipites

Mallophaga: Quadraceps sp.

Vandeleuria oleracea dumeticola (Hodgson, 1845)

Hodgson's Tree Mouse

1841. Mus dumecolus Hodgson. J. Asiat. Soc. Bengal 10: 915 (nom. nud.)

Type locality: Nepal.

1845. Mus (Vandeleuria) dumeticola Hodgson. Ann. Mag. Nat. Hist. 15: 268.

Type locality: Nepal.

1845. Mus povensis Hodgson. Ann. Mag. Nat. Hist. 15: 269.

Type locality: Nepal.

1846. Vandeleuria dumeticola Gray. Cat. Hodgson's Coll. B. M. p. 18.

1891. Vandeleuria oleracea Blanford. The Fauna Brit. India, Mamm. p. 402.

1915. Vandeleuria oleracea marica Thomas. J. Bombay Nat. Hist. Soc. 24(1): 54.

Type locality: Koira, Chaibassa, Orissa.

1947. Vandeleuria oleracea dumeticola (Hodgson), in Ellerman. J. Mammal. 18(3): 363.

Distribution: Nepal, India.

Nepal Records: Hodgson (1841e, p. 915; 1845, pp. 268-269), Gray (1846, p. 18), Hinton and Fry (1923, p. 422).

NEP: 7 specimens: Mitchell - 7.

Habitat: The Terai and midlands in trees, shrubs and bamboo thickets; 100 to 2700 m.

Field Notes: Vandeleuria oleracea dumeticola is a small climbing mouse whose tail is very long (usually exceeding 150% of head and body length) and the feet are adapted for climbing and grasping. The first and fifth toes on all feet are partially opposable and are furnished with a flat nail instead of a claw. The dorsal pelage is fulvous or light chestnut red and the underparts are bright to dull white. The hind foot is quite long (16.1 to 17.6 mm). There are four pairs of mammae, two pectoral and two abdominal.

The skull is characterized by the short rostrum with practically no anteorbital notch. The occipitonasal length usually does not exceed 23 mm.

These rodents are nocturnal and essentially arboreal. Females build a large nest of grasses and dried leaves, usually in a hole or crevice in a tree. The diet consists of fruit, buds and tender plant shoots. The litter size is three to four although litters of six have been recorded (Blanford 1891).

Specimens were collected from the western Terai and

the central midlands; those taken in the Terai were trapped from bamboo thickets and hedge rows, while tree mice collected from the midlands were caught from thickets.

ECTOPARASITES

Parasitoidea: Laelaps algericus
L. echidnina
L. nuttalli

Vandeleuria oleracea modesta Thomas, 1914

Kumaon Tree Mouse

1914. Vandeleuria oleracea modesta Thomas. J. Bombay Nat. Hist. Soc. 23(2): 202.

Type locality: Ramnagar, Kumaon.

Distribution: Kumaon, Nepal midlands.

NEP: 8 specimens: Mitchell - 8.

Habitat: Disturbed areas overgrown with scrub, the central midlands from 1520 to 2430 m.

Field Notes: The Kumaon tree mouse is essentially like V. o. dumeticola, but is distinguished by its brown, rather than reddish, back. The dorsal coat is wood brown which becomes more buffy laterally. The underparts are white or cream color and the feet are dull white. The long tail (130 to 150% of the head and body length) is sparsely haired with a slight terminal pencil. The tail is dusky except for the ventral basal half, which is buffy. There are four pairs

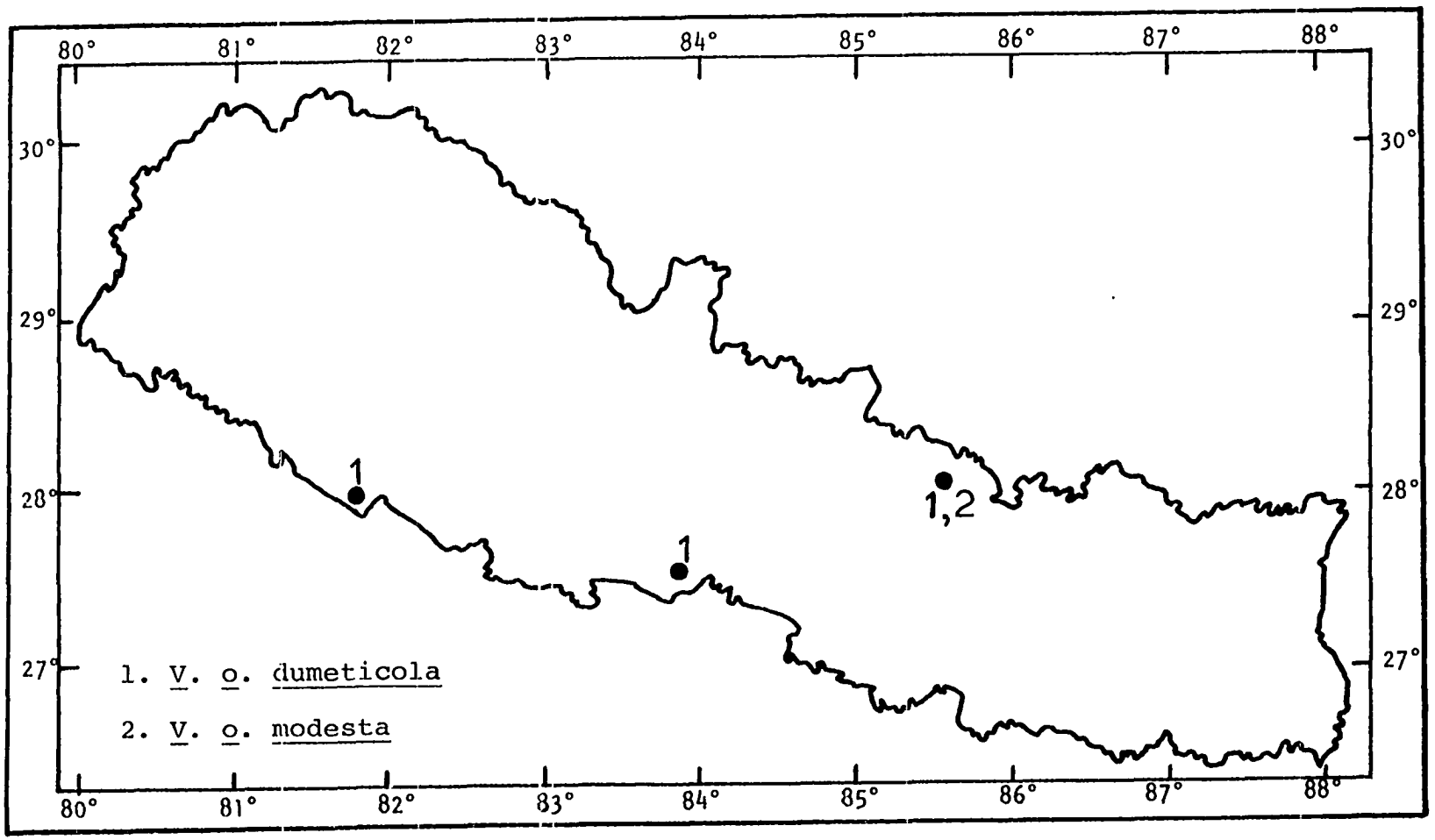


Fig. 37. Collection sites for Vandeleuria oleracea ssp.

of mammae, two pectoral and two abdominal.

The skull is characterized by the short rostrum with practically no anteorbital notch and with the anterior edge of the zygomatic plate slightly concave. The occipitonasal length of five Nepalese specimens is 20.8 to 22.3 mm.

Kumaon tree mice inhabit dense undergrowth in the central midlands, and little is known about their biology. On 17 November, 1967, a single lactating female was collected from Tarke Ghyang. Previously, this species was only known from Kumaon. Eight specimens taken from Tarke Ghyang and Melumche, Sindu District, represent the first collection of this mouse from Nepal. Vandeleuria oleracea modesta occurs sympatrically with V. o. dumeticola in the above two localities.

ECTOPARASITES

Siphonaptera:	Neopsylla secura
Parasitoidea:	Androlaelaps pavlovskii Laelaps algericus
Anoplura:	Hoplopleura capitosa

Apodemus flavicollis gurkha Thomas, 1924

Gurkhali Field Mouse

1924. Apodemus gurkha Thomas. J. Bombay Nat. Hist. Soc. 29(4): 888.

Type locality: Laprak, Gorkha, West Nepal.

1961. Apodemus flavicollis gurkha (Thomas), in Ellerman. Fauna of India, Rodentia. Vol. 3, part 2, p. 499.

Distribution: Western Nepal, possibly Kumaon.

Nepal Records: Thomas (1924, p. 888), Fry (1925, p. 530), Abe (1971, p. 420), Martens and Niethammer (1972, p. 149).

NEP: 101 specimens: Mitchell- 101.

Habitat: The moist forest biotopes of the western midlands, the ecotone between farmland and mixed coniferous forests; from 2500 to 3400 m.

Field Notes: This field mouse is recognized by the overall smoke gray color and a tail that is much longer than the head and body. The short fur is rather soft. The medium-sized ears are blackish, darker than the head. The feet are pale white and the tail is blackish gray above and a dull white below. Females have eight mammae, two pairs pectoral and two pelvic.

The skull has a broad braincase with a moderately long rostrum. The nasals usually project slightly forward over the incisors. The lower cheek teeth possess the characteristic structure of the genus; the terminal heel of M_1 and M_2 is well-developed and the trilobular character of M_3 is well-marked (Ellerman 1941).

These field mice feed on grains, seeds, berries and roots. According to Abe (1971), insects constitute, by

volume, more than 50% of their diet. They mate when several months old and have up to six litters a year. The gestation period is 21 to 29 days and the number of young is two to nine (Walker et al. 1964b). Our field data suggest that females have two to three litters annually and that young are born during April-May and August-September. Specimens collected from January through March included no pregnant females, although 17% of the males had enlarged testes.

In the western midlands, Apodemus were collected from cultivated fields along the edge of coniferous forests. Traps were set along rock walls and around stumps and tree roots. They were never collected near human settlements. In January and February of 1969, these field mice were collected from subalpine biotopes in Dhorpatan, Dolpa District. They made up 51% of the entire catch of mammals from Dhorpatan and they remained active even though the temperature dropped to a low of -10°C. In March, another large series was taken from Maharigaon, Jumla District. Again, they made up the bulk of the catch. Here, they coexisted with Apodemus sylvaticus; these two field mice are usually allopatric species, with A. sylvaticus inhabiting the more arid northern regions of the inner Himalayas and Tibetan steppe.

ECTOPARASITES

Siphonaptera: Citellophilus atallahi
Frontopsylla spadix

	Neopsylla angustimanubra
	N. marleaneae
	N. secura
	Nosopsyllus punjabensis
	Palaeopsylla helenae
	Paradoxopsyllus acanthus
	P. digitatus
	P. n. sp.
	Stenischia n. sp.
Ixodoidea:	Ixodes sp. A.
	I. sp. B.
Parasitoidea:	Androlaelaps soricinus
	Eulaelaps indescretus
	E. stabularis
	Haemogamasus nidiformis
	Histionyssus latiscutatus
	Hypoaspis sardoa
	Laelaps algericus
	L. turkestanica
	Myonyssus montanus
	Amerosiidae
	Pyemotidae
Uropodoidea:	Uropodina sp.
Anoplura:	Hoplopleura pacifica

Apodemus sylvaticus wardi (Wroughton, 1908)

Common Field Mouse

1908. Micromys sylvaticus wardi Wroughton. J. Bombay Nat. Hist. Soc. 18: 282.

Type locality: Saspul, Ladak.

1941. Apodemus sylvaticus wardi (Wroughton), in Ellerman. Families and Genera of Living Rodents. Vol. 2, p. 98.

1961. Apodemus flavicollis wardi (Wroughton), in Ellerman. Fauna of India, Rodentia. Vol. 3, Part 2, p. 499.

Distribution: Kashmir, Kumaon and Nepal west of the

Kali Gandaki River.

Nepal Records: Martens and Niethammer (1972, p. 148).

NEP: 199 specimens: Mitchell - 199.

Habitat: The subalpine and alpine northern regions of the western midlands between 3000 and 4000 m, along the edge of cultivation and coniferous forests; the arid alpine region of the Mustang District.

Field Notes: This field mouse is rufous brown dorsally and white or pale yellowish gray ventrally, the two colors being sharply divided. The tail is often shorter than the head and body. The fur is soft and rather long. The ears are quite large (16 to 19 mm). The tail is nearly naked, with a sparse growth of hair throughout its length. It is bicolored, dark brown above and white below. Six mammae are present, one pair pectoral and two pelvic.

The occipitonasal length is generally less than 27 mm and the palate is long, usually more than half the occipitonasal length.

The dietary habits of these mice are similar to those of A. flavicollis. They do some damage to the grain crops.

Little is known about the reproductive biology; Ellerman (1941) reported a litter size of five to seven. Pregnant females, one with five and another with six embryos, were collected on 10 February and 11 March. Males with enlarged testes were taken in March. The peak breeding season

is March and April; litters are dropped in April and May after a gestation period of approximately 23 to 29 days.

Martens and Niethammer (1972) were the first to report A. s. wardi from Nepal. The NEP collected large numbers of these mice from Maharigaon, Rara Lake, Jomosom and Kalapani. They were taken from stone walls around grain fields. In winter, specimens were taken from inside houses and livestock shelters.

ECTOPARASITES

Siphonaptera:	Amphipsylla n. sp.
	Ctenophyllus n. sp.
	Frontopsylla spadix
	Neopsylla secura
	Nosopsyllus punjabensis
	Palaeopsylla tauberi
	Paradoxopsyllus acanthus
	P. n. sp.
	P. magnificus
	P. oribatus
	P. spinosus
	Rhadinopsylla n. sp.
	Stenischia n. sp.
Ixodoidea:	Anomalohimalaya lama
	Dermacentor everestianus
	Ixodes sp.
	I. sp. B.
Parasitoidea:	Androlaelaps sp.
	Eucheyletia sinensis
	Eulaelaps indescretus
	E. stabularis
	Haemogamasus oliviformis
	Hypoaspis sardoa
	Laelaps algericus
	L. agilis
	L. traubi
	L. turkestanica
	Myonyssus montanus

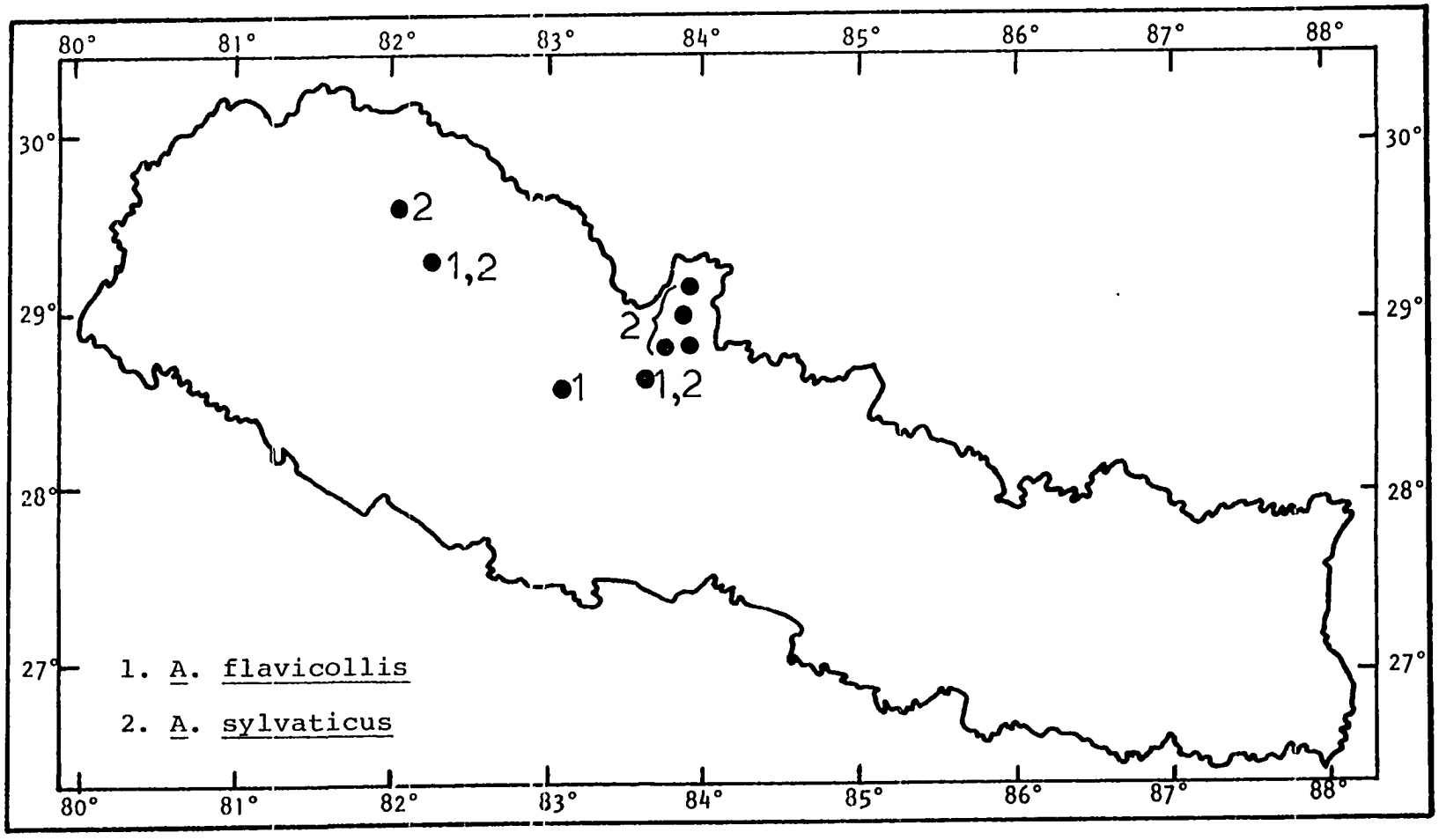


Fig. 38. Collection sites for Apodemus sp.

Anoplura: Hoplopleura captiosa
H. pacifica
H. affinis

Millardia meltada pallidor Ryley, 1914

Soft-furred Field Rat, Metad

1914. Millardia meltada pallidor Ryley. J. Bombay Nat. Hist. Soc. 22: 659.

Type locality: Lunwa, Palanpur, Gujerat, India.

1917. Millardia meltada dunni Thomas. J. Bombay. Nat. Hist. Soc. 25: 202.

Type locality: Handiserah, Ambala, Punjab.

1961. Rattus meltada pallidor Ellerman. Fauna of India, Rodentia. Vol. 3, part 2, p. 697.

Distribution: Nepal Terai, Punjab, Gujerat.

Nepal Records: Hinton and Fry (1923, p. 422).

NEP: 5 specimens: Mitchell - 5.

Habitat: The western Terai and the Dang Valley in scrub jungle bordering rice and wheat fields.

Field Notes: The soft, dense fur and large, rounded ears distinguish the metad from other rats of the area. Dorsally the color is pale brownish gray and on the underside it is grayish white. The tail is nearly equal in length to the head and body. The hindfoot is specialized, with a short fifth toe and a reduced number of plantar pads. The sole has four well-developed plantar pads with a much reduced fifth posterior one (Rattus species have five well-developed

plantar pads). There are four pairs of mammae.

The auditory bullae are small, rarely exceeding 6.5 mm in length. They are less than 20% of the occipitonasal length, which usually does not exceed 35 mm. In Rattus species, the auditory bullae are enlarged, averaging 25% of the occipitonasal length.

Metads are found chiefly near cultivated fields, but they also inhabit dense scrub jungle. According to Prater (1965), they live in pairs or small colonies. The diet consists of grain, seeds and vegetables. In India, metads do extensive damage to rice paddies and other grain crops.

A lactating female and one bearing six uterine scars were the only reproductively active adults caught. Females are known to have litters of six to eight (Prater 1965).

In April, 1968, five specimens were collected from the western Terai and the Dang Dun. They were trapped from thorn-brush fences surrounding rice paddies and from shallow burrows around wheat fields. These rats were collected in conjunction with Golunda ellioti myothrix, Mus booduga, Rattus r. brunneusculus and Tatera indica.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis Stivalius aporus
Ixodoidea:	Haemaphysalis bispinosa H. sp.

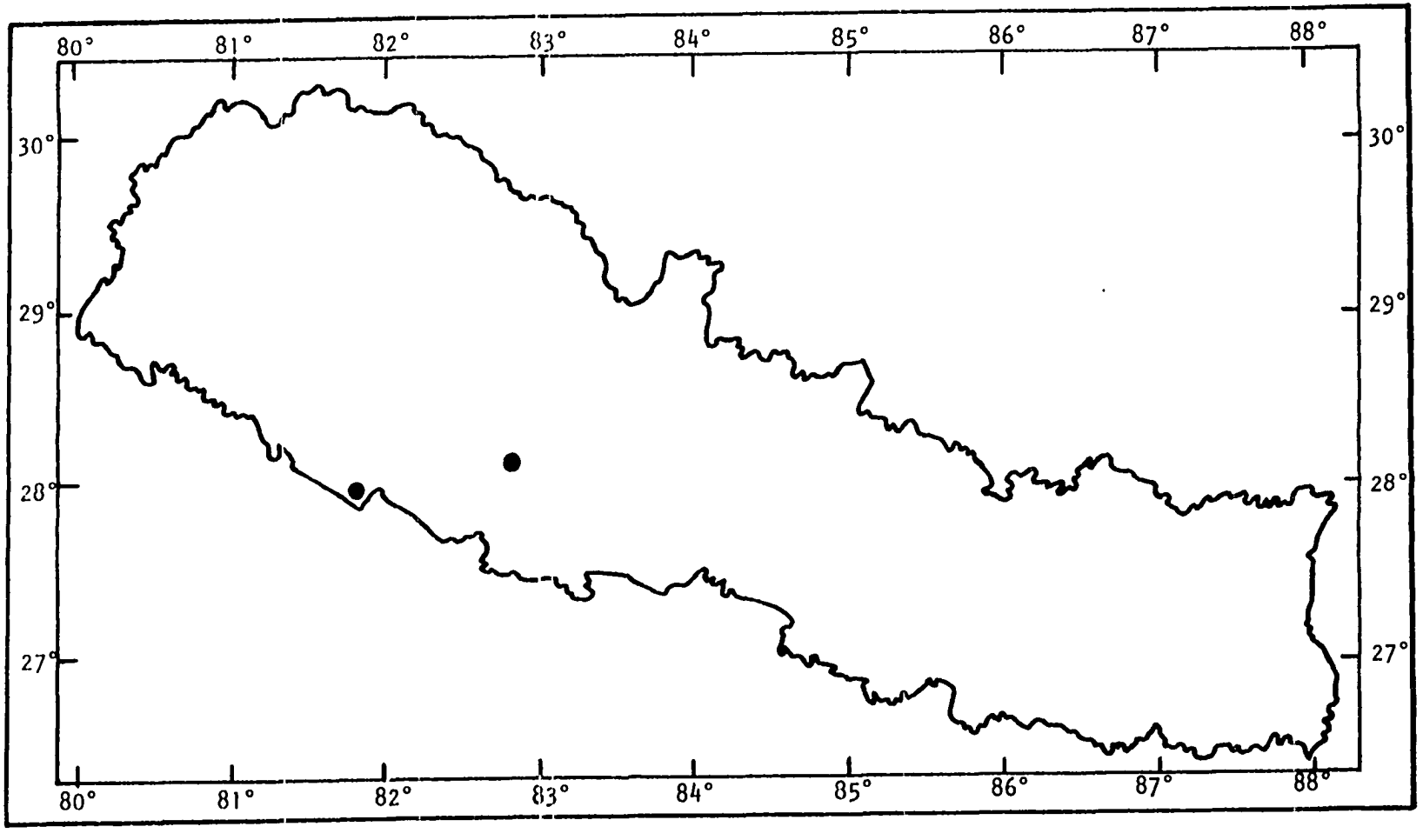


Fig. 39. Collection sites for Millardia meltada pallidor

Parasitoidea: Gahrliepia (Schoengastiella) sp.
Laelaps sp.
L. myonyssognathus
L. nuttalli
L. traubi

Mallophaga: Trichodectes sp.

Anoplura: Hoplopleura pacifica

Rattus rattus ssp. Linnaeus, 1758

House Rat; Black Rat

Distribution: Cosmopolitan in the Himalayas.

NEP: 59 specimens: Maser - 27; Mitchell - 24; AVWE - 8.

Habitat: The structure biotope of the midlands and the Tibetan Plateau, from 2200 to 3700 m.

Field Notes: A series of large rats that are taxonomically difficult to place to subspecies was collected from dwellings in the midlands and the Tibetan Plateau. The dorsal pelage is yellowish brown or brown and the belly is light gray. There are no osteological characters that separate this species consistently from Rattus turkestanicus with skulls of similar size. They differ from R. turkestanicus in having unicolored tails that average 90% or less of the total length. The number of mammae is usually 10.

These commensal rodents were collected from the Mustang, Sindu and Solukhumbu Districts, all specimens being trapped from areas above 2500 m. Omnivorous in food habits, they

contaminate stored supplies. Their breeding biology is probably similar to that of other commensal forms of rats.

In 1955 Biswas and Khajuria described what they considered a new subspecies, R. r. khumbuensis, based on a single specimen collected from the Solukhumbu District. Worth and Shah (1969) collected a series of Rattus rattus tistae from the Langtang Valley. Both of these subspecies occupy the same habitat as specimens in our Rattus rattus ssp. series.

ECTOPARASITES

Siphonaptera:
- Frontopsylla spadix
- Neopsylla marleaneae
- N. secura
- N. stevensi
- Nosopsyllus punjabensis
- N. simla
- Paradoxopsyllus custodis
- P. paraphaeopis
- P. spinosus
- Pulex irritans
- Stivalius aporus
- Xenopsylla astia

Ixodoidea:
- Boophilus microplus
- Ixodes lindbergi (="ovatus")
- I. redikovzevi group
- I. sp.
- I. sp. A
- Rhipicephalus turanicus

Parasitoidea:
- Androlaelaps pavlovskii
- Haemogamasus dorsalis
- H. fenilis
- Histionyssus sp.
- Laelaps algericus
- L. echidnina
- L. nuttalli
- L. traubi

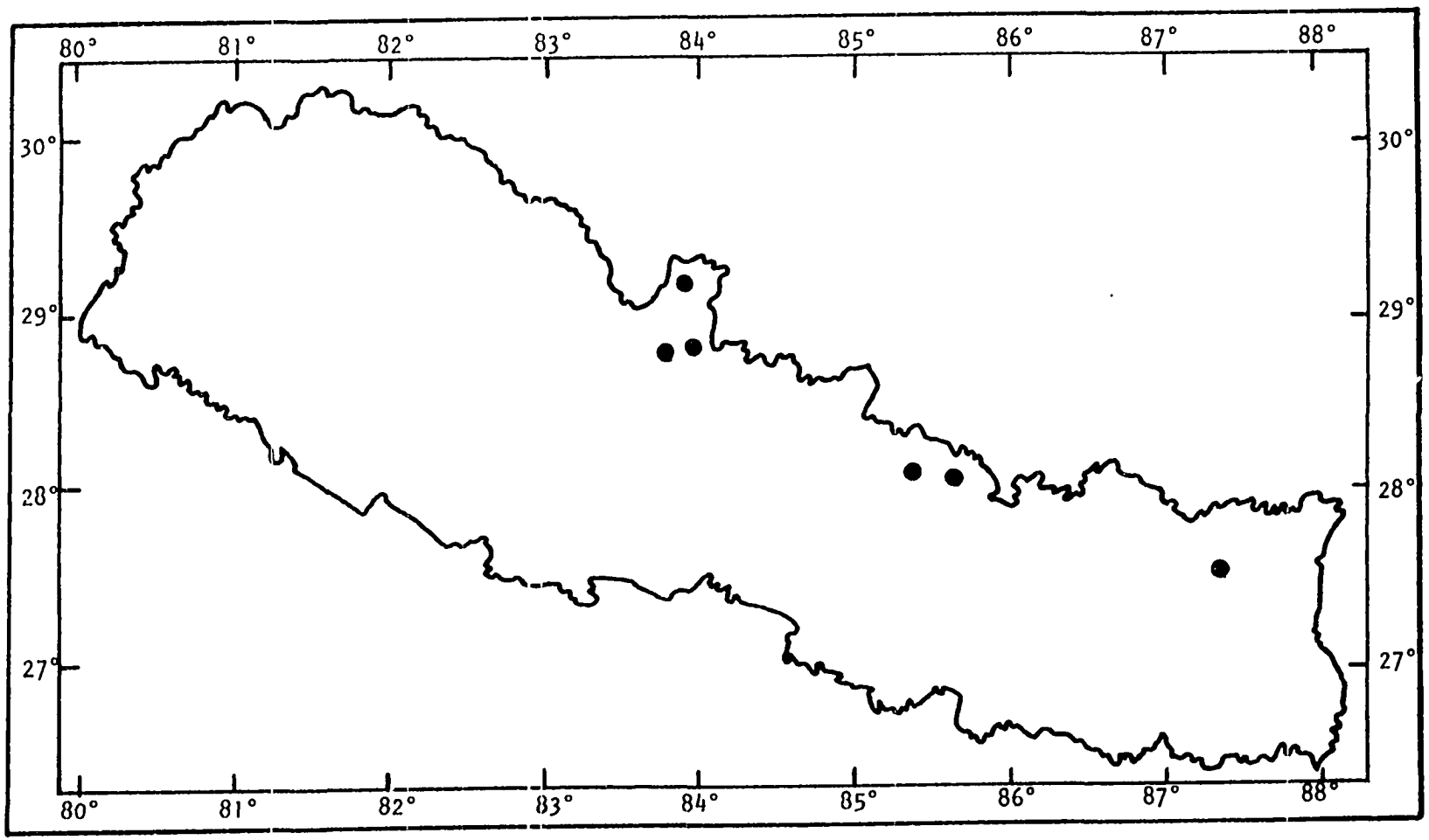


Fig. 40. Collection sites for Rattus rattus ssp.

	L. turkestanica
	L. sp.
	Liponyssoides muris
	Myonyssus tuberosus
	Ornithonyssus bacoti
Mallophaga:	Colpocephalum fregili
	Myrsidea sp.
Anoplura:	Hoplopleura pacifica
	Polyplax asiatica
	P. sp.

Rattus rattus brunneus (Hodgson, 1845)

Nepalese House Rat

1845. Mus brunneus Hodgson. Ann. Mag. Nat. Hist. 15: 266.

Type locality: Nepal.

1922. Rattus rattus brunneus (Hodgson), in Hinton. J. Bombay Nat. Hist. Soc. 28(4): 1058.

Distribution: Nepal.

Nepal Records: Hodgson (1845, p. 266), Hinton (1922b, p. 1058), Hinton and Fry (1923, p. 420), Worth and Shah (1969, p. 126), Abe (1971, p. 417).

NEP: 48 specimens: Maser - 27; Mitchell - 21.

Habitat: The broad valleys of the Mahabharat Lekh and the midlands from 900 to 2100 m.

Field Notes: The tail length of this large commensal rat is usually more than 120% of the head and body. The upper parts are dark brown, somewhat grizzled with gray or black. The venter is dusky with a rusty or buffy tinge.

There are 12 mammae.

The occipitonasal length usually exceeds 44 mm and the upper tooth row approaches 7 mm. The palatal foramina are short, averaging 17.8% of the occipitonasal length.

These rats are common pests in dwellings in the Kathmandu Valley. Their diet consists of grains, fruits and vegetable matter and they do extensive damage to stored products and field crops.

The number of young per litter is three to nine and three to four litters are produced annually. The peak breeding periods are pre- and post-monsoons with young born in May-June and September-October. Of 21 specimens collected in September, nine were immatures. Three of the five females were either carrying embryos or possessed uterine scars. A female collected on 10 September had six embryos and two females taken on 14 September bore seven and four uterine scars.

All the previous collection records of R. r. brunneus (Hinton 1922b ; Hinton and Fry 1923) were from the Kathmandu Valley with the exception of those of Worth and Shah (1969) and Abe (1971), who collected R. r. brunneus from the Pokhara Valley. In September, 1970, the NEP collected 21 specimens from Gokarna, the Kathmandu Valley.

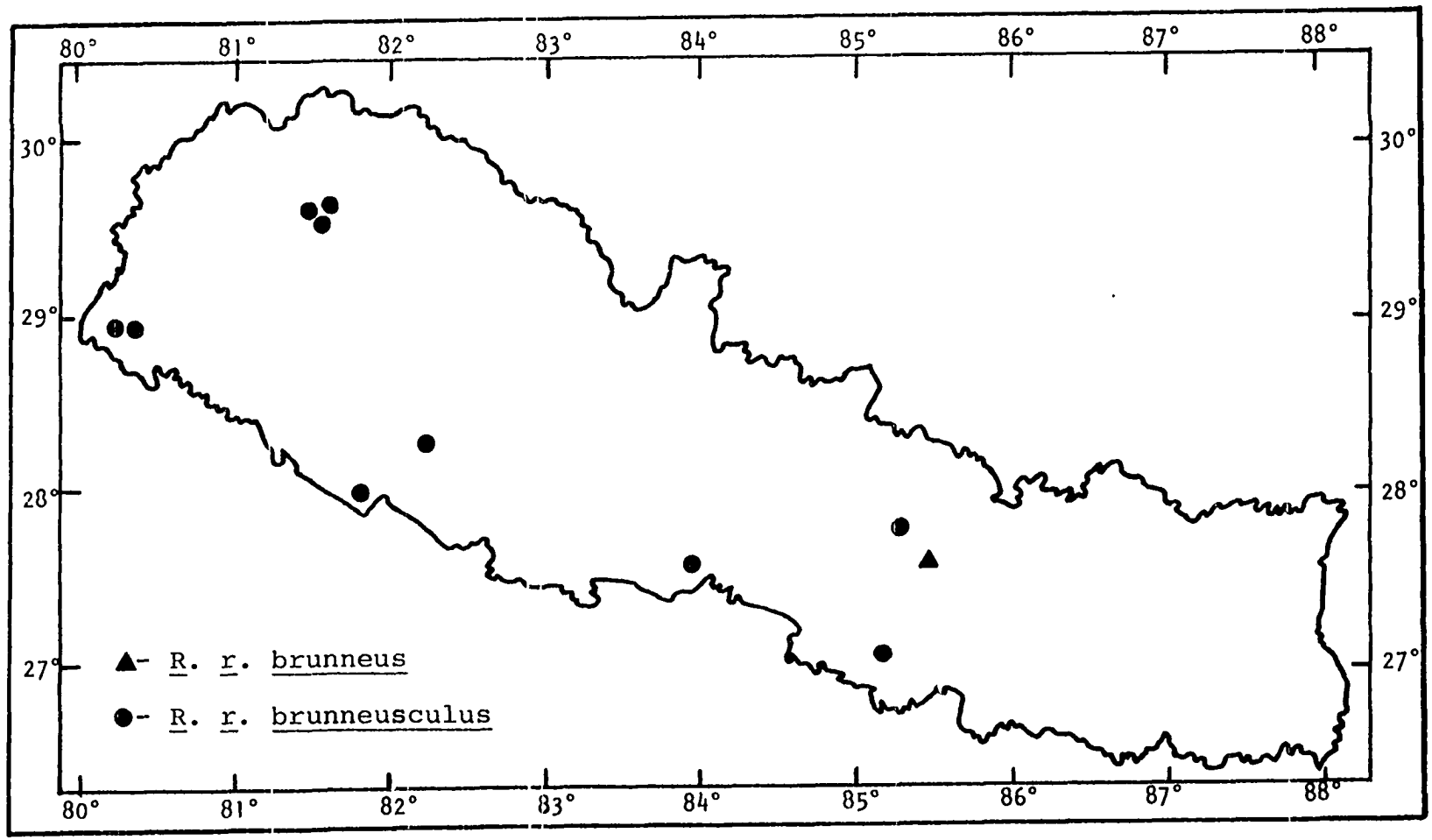


Fig. 41. Collection sites for Rattus rattus brunneus and R. r. brunneusculus

ECTOPARASITES

Siphonaptera: Acropsylla episema
Nosopsyllus punjabensis
Xenopsylla cheopis

Ixodoidea: Haemaphysalis bispinosa
H. montgomeryi
Ixodes redikorzevi group

Rattus rattus brunneusculus (Hodgson, 1845)

Lesser Nepalese Brown Rat

1845. Mus brunneusculus Hodgson. Ann. Mag. Nat. Hist. 15: 267.

Type locality: Nepal.

1919. Rattus rattus sikkimensis Hinton. J. Bombay Nat. Hist. Soc. 26(2): 394.

Type locality: Pashok, Sikkim.

1922. Rattus rattus brunneusculus (Hodgson), in Hinton. J. Bombay Nat. Hist. Soc. 28(4): 1057.

Distribution: Nepal, Darjeeling, Sikkim.

Nepal Records: Hodgson (1845, p. 267), Hinton (1919, p. 394; 1922b, p. 1057), Hinton and Fry (1923, p. 420), Fry (1925, p. 259), Worth and Shah (1969, p. 126), Abe (1971, p. 418).

NEP: 54 specimens: Mitchell - 54.

Habitat: A number of biotopes in the Terai, duns, Siwaliks, Mahabharat Lekh and midlands, from 90 to 2400 m.

Field Notes: Rattus rattus brunneusculus differs from

R. r. brunneus in cranial features, size, coloration and habitat preference. It is not as powerfully built as R. r. brunneus (Table 11). The color of the back is bright rusty brown; the underparts are yellowish white with the lateral lines of demarcation sharply defined. The tail averages 124% of the head and body length. Females have six pairs of mammae.

The cranial features are: (1) the occipitonasal length is usually less than 42 mm, (2) the upper tooth row approximates 6.6 mm and (3) the auditory bullae are usually less than 17% of the occipitonasal length.

These rats are the most widespread rodent in Nepal, occurring in at least five major life zones. In the Terai and duns, they are feral, but at higher elevations, they are associated with human habitations. Somewhat arboreal in habit, they have been reported to nest in trees (Abe 1971). They are omnivorous and do considerable damage to crops and stored goods.

The peak period of reproductive activity is pre-monsoon. Over half of the adults collected in April were either sexually mature or had mated. Of the 17 adults examined, two males had enlarged testes, three females were pregnant, three were lactating and one bore uterine scars. The three pregnant females carried five, seven and five embryos, respectively. Of six females collected in July, four

Table 11. Comparison of skin measurements of Rattus rattus brunneus with those of R. r. brunneusculus (in mm).

	R. r. brunneus (11)	R. r. brunneusculus (17)
Total length	325.6 - 353.4	380.1 - 408.4
Tail	180.5 - 196.8	206.9 - 213.6
Hind foot	32.8 - 35.2	36.7 - 38.8
Ear	19.8 - 23.8	24.0 - 27.9

were lactating and one had four embryos. The litter size ranges from four to seven and two to three litters are produced annually.

In the Terai and duns, these rats were collected with Bandicota bengalensis, Millardia meltada and Tatera indica. There are reports of this species occurring sympatrically with R. r. brunneus in the Pokhara Valley (Worth and Shah 1969; Abe 1971).

ECTOPARASITES

Siphonaptera:	Nosopsyllus punjabensis
	N. simla
	Stivalius aporus
	Xenopsylla astia
Ixodoidea:	Dermacentor auratus
	Haemaphysalis bispinosa
	H. spinigera
	Hyalomma sp.
	Rhipicephalus haemaphysaloides
Parasitoidea:	Androlaelaps hermaphrodita
	Hypoaspis sp.
	Laelaps echidnina
	L. myonyssognathus
	L. nuttalli
	L. sp.
Mallophaga:	Lipeurus sp.
Anoplura:	Hoplopleura pacifica
	Polyplax sp.

Rattus nitidus nitidus (Hodgson, 1845)

Himalayan Rat; Nepal Shiny Rat

1845. Mus nitidus Hodgson. Ann. Mag. Nat. Hist. 15: 267.

Type locality: Nepal.

1845. Mus horeites Hodgson. Ann. Mag. Nat. Hist. 15: 268.

Type locality: Nepal.

1849. Mus aequicaudalis Hodgson. Ann. Mag. Nat. Hist. 3: 203.

Type locality: Nepal.

1879. Mus rubricosa Anderson. Anat. Zool. Res. Yunnan. p. 306.

Type locality: Ponsee and Hotha, western Yunnan.

1891. Mus rattus var. nitidus Blanford. The Fauna Brit. India, Mamm. p. 407.

1914 Epimys nitidus (Hodgson), in Wroughton. J. Bombay Nat. Hist. Soc. 23(2): 296.

1916. Rattus nitidus (Hodgson), in Wroughton. J. Bombay Nat. Hist. Soc. 24(3): 795.

Distribution: Kumaon, Nepal, Sikkim, Bhutan, Assam, Burma, Western Yunnan.

Nepal Records: Hodgson (1845, pp. 267-268), Gray (1846, p. 18), Horsfield (1849, p. 203), Thomas (1881, p. 533), Hinton (1922b, p. 1063), Hinton and Fry (1923, p. 421), Worth and Shah (1969, p. 126), Abe (1971, p. 417).

NEP: 16 specimens: Mitchell - 9; Maser - 7.

Habitat: Moist, rocky biotopes of the midlands and structure biotopes of the inner Himalayas; between 2100 and

4300 m.

Field Notes: Rattus n. nitidus resembles a commensal form of Rattus rattus. The back is dark gray, occasionally with a darker mid-dorsal patch or line; the underparts are dull gray to blue gray. The fur is soft and thick. The tail, which is a little longer than the head and body, is nearly naked. Twelve mammae are usually present.

The skull often exceeds 40 mm in length and has well-developed supraorbital ridges. The nasals are long (40% or more of the occipitonasal length) and the auditory bullae are inflated (15% or more of the occipitonasal length).

Hodgson (1845) stated, "It is a house rat, but it is rare and frequents the mountains rather than the valleys." Hinton and Fry (1923) found this species rare in Nepal, but they collected large numbers from Kumaon and Sikkim. Both feral and commensal forms were collected. In spring, these rats nest in stone fences surrounding field crops, but in winter, they occupy houses and livestock compounds.

The diet consists of seeds and grains, but insects were also found in the stomach contents of two specimens. Apparently this species breeds before and after the monsoon rains. Two immatures were collected in August and a male with enlarged testes was taken in November.

The NEP collected these rats from the central midlands (Kakani, Melumche, Phulung Ghyang) and from Khumjung in the

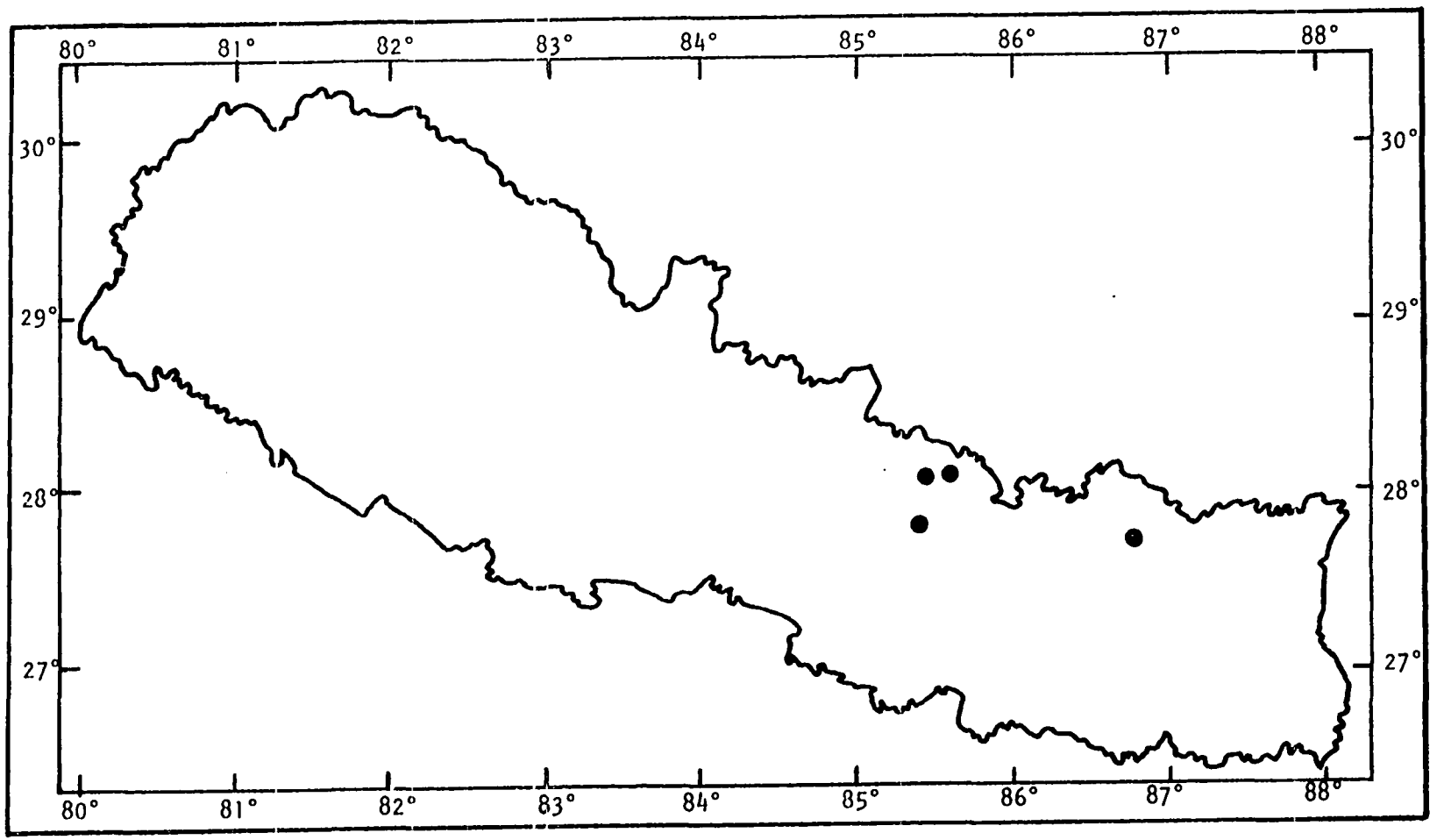


Fig. 42. Collection sites for Rattus nitidus

inner Himalayas. All specimens were taken above 2500 m. Worth and Shah (1969) reported collecting R. nitidus from the Pokhara Valley (910 m) and the Langtang Valley (3310 m). Since all the collections previous to Worth and Shah were taken from above 2000 m, it is doubtful that the specimens taken from the Pokhara Valley were R. nitidus. In the central midlands, these rats coexist with R. niviventer, R. rattus and R. turkestanicus.

ECTOPARASITES

Siphonaptera:	Neopsylla marleaneae
	N. secura
	N. stevensi
Parasitoidea:	Haemogamasus oliviformis
	Histionyssus latiscutatus
	Laelaps algericus
	L. echidnina
	L. traubi
	L. turkestanica
Anoplura:	Hoplopleura oenomydis
	H. pacifica
	H. sicata
	Polyplax pricei
	P. serrata
	P. sp.

Rattus turkestanicus (Satunin, 1903)

Turkestan Rat

1845. Mus rattoides Hodgson. Ann. Mag. Nat. Hist. 15: 267.

Type locality: Nepal.

1903. Mus turkestanicus Satunin. Ann. Mus. St. Petersberg 7: 588.

Type locality: Assam-bob, Fergana, Russian Turkestan.

1903. Mus vicerex Bonhote. Ann. Mag. Nat. Hist. 11: 473.

Type locality: Simla, Himachal Pradesh, India.

1913. Epimys rattus shigarus Miller. Proc. Biol. Soc. Washington 26: 198.

Type locality: Shigar, Baltestan, Kashmir.

1914. Epimys vicerex Wroughton. J. Bombay Nat. Hist. Soc. 24: 489.

Type locality: Chuntang, Sikkim.

1920. Rattus vicerex Wroughton. J. Bombay Nat. Hist. Soc. 26: 798.

Type locality: Simla, Himachal Pradesh, India.

1958. Rattus rattoides gilgitianus Akhtar. Pak. J. Sci. Res. 11: 41.

Type locality: Gilgit, Pakistani Kashmir.

1971. Rattus turkestanicus (Satunin), in Schlitter and Thonglongya. Proc. Biol. Soc. Washington 84(20): 171.

Distribution: Moghan, Iran, Afghanistan, south Russian Turkestan, Kashmir, Himachal Pradesh, Nepal, Sikkim.

Nepal Records: Hodgson (1845, p. 267), Hinton and Fry (1923, p. 421), Worth and Shah (1969, p. 126), Weigel (1969, p. 150), Abe (1971, p. 414).

NEP: 90 specimens: Mitchell - 89; AVWE - 1.

Habitat: Structure biotopes of the eastern and western midlands and agricultural areas in oak, rhododendron, and coniferous forests, from 2200 to 3100 m.

Taxonomic Notes: Schlitter and Thonglongya (1971) have proposed Rattus turkestanicus (Satunin, 1903) as the valid name for Rattus rattoides Hodgson, 1845. Since the name Mus rattoides (Hodgson, 1845) is preoccupied by and consequently a homonym of Mus rattoides (Pictet and Pictet, 1844), the next available name for this species is Rattus turkestanicus (Satunin, 1903).

Schlitter and Thonglongya (1971) recognized three subspecies of R. turkestanicus formerly assigned to R. rattoides: R. turkestanicus turkestanicus, R. turkestanicus shigarus (Miller, 1913) and Rattus turkestanicus vicerex (Bonhote, 1903). Another subspecies (R. turkestanicus gilgitianus) has been reported from Gilgit, Pakistani Kashmir (Akhtar 1958). Ellerman and Morrison-Scott (1966) prefer to recognize two subspecies: R. rattoides rattoides (Hodgson), a dull or gray bellied race, and Rattus rattoides turkestanicus (Satunin), a white bellied race.

Field Notes: The species as understood comprises forms which coexist extensively with Rattus rattus, from which these rats are not always distinguishable cranially. The bicolored tail, dark above and pale below, is the sole criterion that Ellerman (1947b) used to distinguish R. turkestanicus from R. rattus.

Dorsally, the color varies from pale gray to a reddish brown; the ventral pelage is a dull gray to a dirty white.

The feet are usually white. The coat is somewhat harsh with long, spiny guard hairs interspersed. The number of mammae is usually 12, but sometimes there are only 10.

The auditory bullae are large (about 17% of the occipitonasal length) and the supraorbital ridges of the skull are well-developed.

Turkestan rats are commensal and all specimens were taken from structural biotopes (houses, grist mills and livestock sheds) and from stone walls surrounding crops. Their diet consists of plant and vegetable matter as well as insects (Abe 1971). These rats also destroy stored foods and grains.

The breeding season runs from mid-March until early October with peak reproductive activity in May. Over 70% of the specimens taken in May were sexually mature adults: 67% of the males had enlarged testes, 67% of the females bore uterine scars, the remaining 33% of the females carried embryos. Two females captured in mid-March bore uterine scars while a female taken 20 November was still lactating. Five females bearing embryos were taken between May and October (Table 12). Rats of this species having a total length of less than 275 mm are considered subadults. Approximately 18% of the May catch consisted of subadults as compared to over 60% for August.

Table 12. Female Rattus turkestanicus bearing embryos.

Host number	Number of Embryos	Length (in mm)	Date
957	2	17.1	14 August 1968
2711	3	16.0	28 May 1969
2759	3	13.3	29 May 1969
3179	6	16.3	3 October 1969
3207	5	6.8	4 October 1969

Both gray and white bellied forms of R. turkestanicus were collected in Nepal. White bellied individuals were taken in the eastern midlands; gray bellied forms were trapped in the central and western midlands. Specimens of R. turkestanicus were never collected in the duns, Mahabharat Lekh or Siwalik life zones or below 2000 m; other forms of murids (Rattus rattus and Bandicota sp.) replace them at lower elevations. In the midlands they coexist with R. fulvescens, R. nitidus, R. niviventer and R. rattus.

ECTOPARASITES

Siphonaptera:
Ctenophylius n. sp.
Frontopsylla spadix
Neopsylla marleaneae
N. secura
Nosopsyllus punjabensis
Palaeopsylla tauberi
Paradoxopsyllus acanthus
P. custodis
P. digitatus

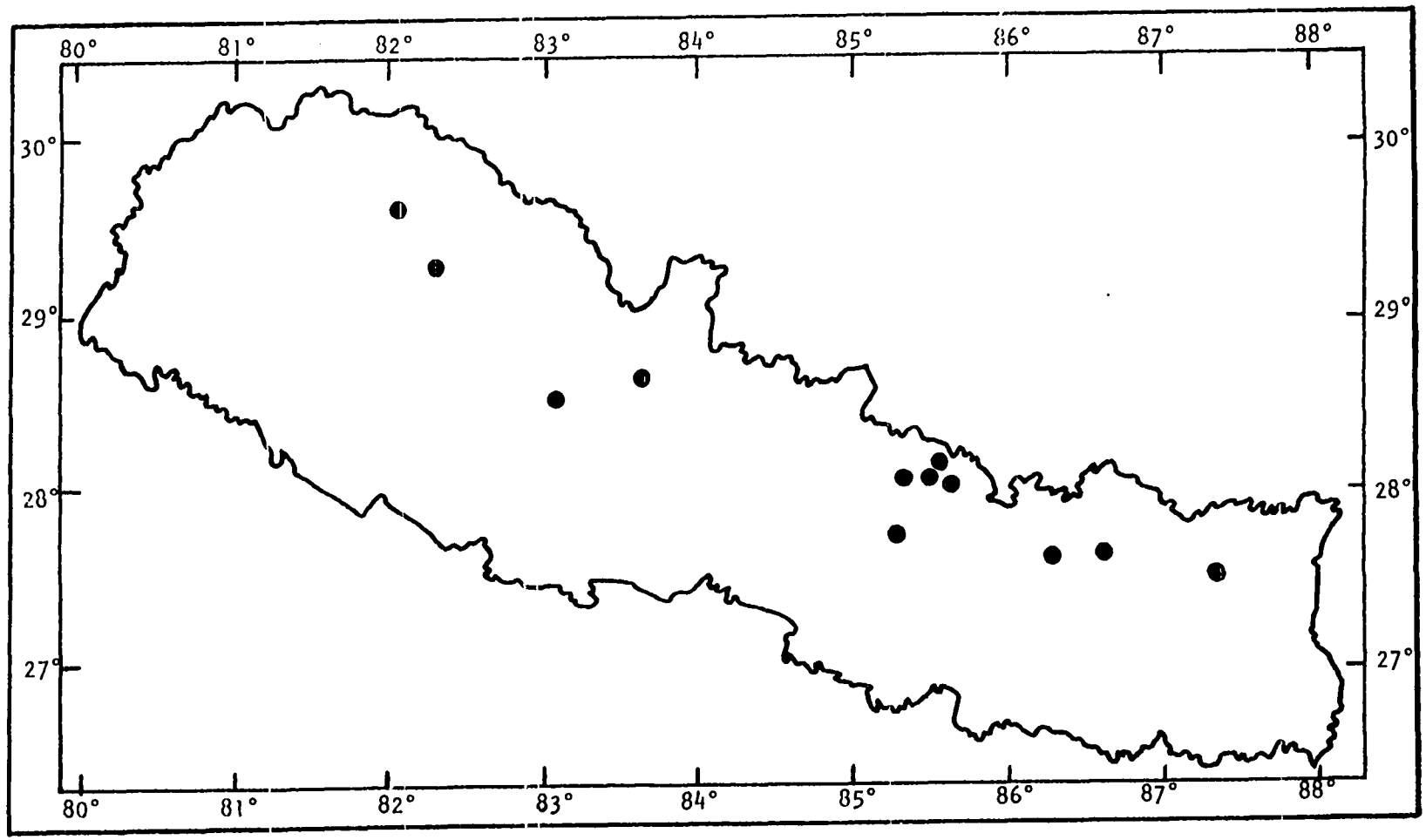


Fig. 43. Collection sites for Rattus turkestanicus

	P. mustangensis
	P. n. sp.
Ixodoidea:	Haemaphysalis montgomeryi
	H. sp.
	Ixodes acutitarsus
	I. sp. A
	I. sp. B. facies
	Rhipicephalus haemaphysaloides
	R. turanicus
Parasitoidea:	Androlaelaps pavlovskii
	Eucheyletia sinensis
	Haemogamasus nidiformis
	Histionyssus latiscutatus
	Hypoaspis sardoa
	H. sp.
	Laelaps algericus
	L. turkestanica
	Macrochelidae
	Pachylaelapidae
	Parasitidae
Anoplura:	Hoplopleura oenomydis
	H. pacifica
	Polyplax sp.

Rattus niviventer niviventer (Hodgson, 1836)

White-bellied Rat

1836. Mus (Rattus) niviventer Hodgson. J. Asiat. Soc. Bengal 5: 234.

Type locality: Kathmandu, Nepal.

1845. Mus niviventer Hodgson. Ann. Mag. Nat. Hist. 15: 267.

Type locality: Central region of Nepal.

1846. Mus rattus niviventer Gray. Cat. Hodgson's Coll. B. M. p. 18.

1891. Mus niviventer Blanford. The Fauna Brit. India, Mamm. 2: 412.

1916. Rattus niviventer (Hodgson), in Wroughton. J. Bombay Nat. Hist. Soc. 24(3): 792.

Distribution: Himalayas: Kumaon, Nepal, Sikkim.

Nepal Records: Hodgson (1836c, p. 234; 1845, p. 267), Gray (1846, p. 18), Hinton and Fry (1923, p. 421), Fry (1925, p. 529).

NEP: 33 specimens: Mitchell - 31; Maser - 1; AVWE - 1.

Habitat: In houses and fields throughout the central and eastern midlands, from 2100 to 2700 m.

Field Notes: Rattus niviventer is similar in size and appearance to R. nitidus, but is grayish brown dorsally, with pure white underparts. The distinctly bicolored tail averages 112% or more of the head and body length. The toes are usually white and the feet vary from brownish to white. Four pairs of mammae are present.

Its diet consists of seeds, grains and vegetable matter. Breeding is continuous throughout the summer without the distinct pre- and post-monsoon peaks of activity as exhibited in the other forms of Rattus. Females have three to four litters a season with a litter size of three to eight. On 1 August, a female taken had six embryos that averaged 13.2 mm in length. Lactating females were collected in June, August and September and males with enlarged testes were taken in April, May and September. All specimens less than 200 mm in length were considered subadults.

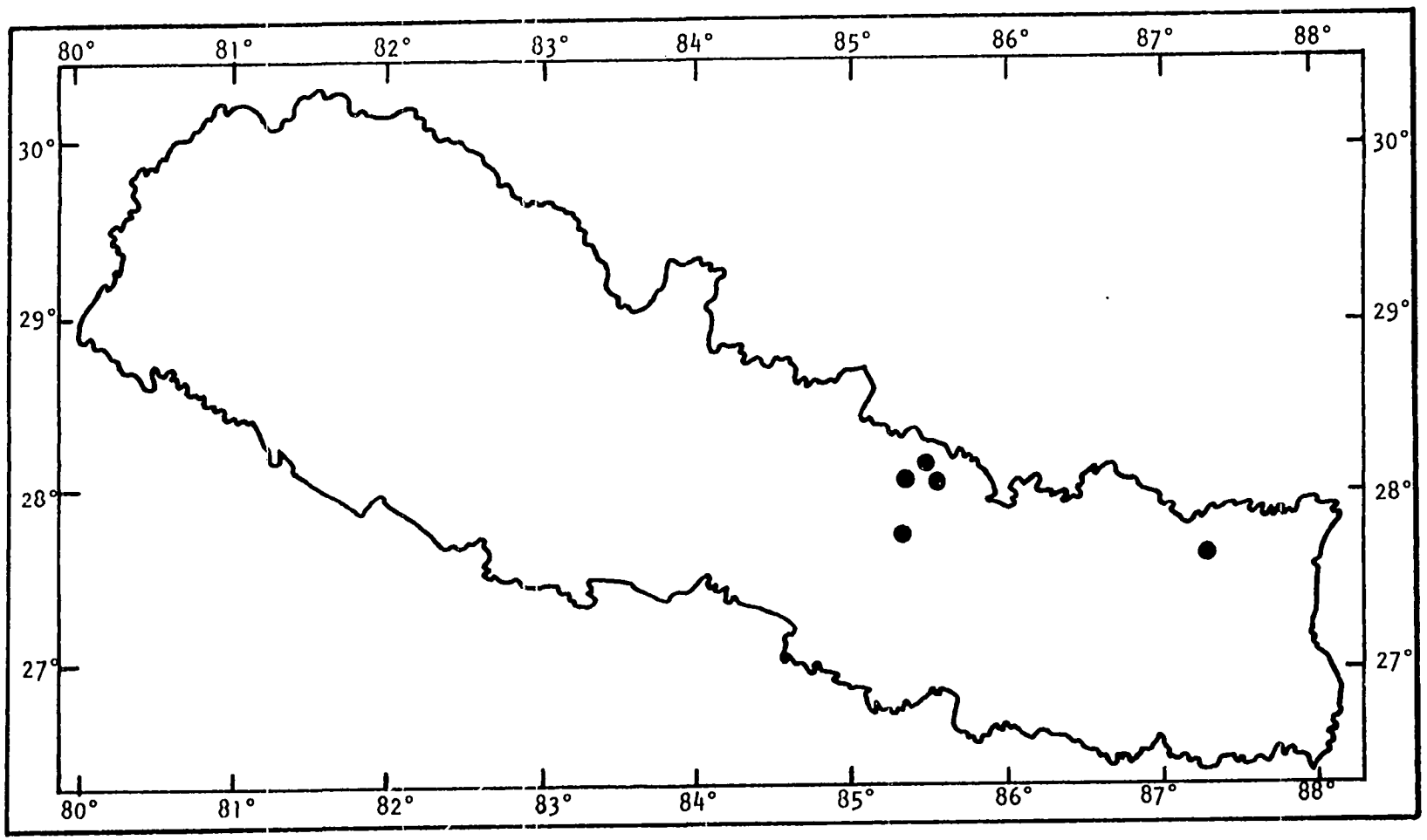


Fig. 44. Collection sites for Rattus niviventer

Immatures comprised 27% of the specimens collected in May.

These rats are commensal in habit, infesting the local dwellings throughout the central midlands. They were collected in conjunction with R. fulvescens, R. nitidus, R. rattus and R. turkestanicus.

ECTOPARASITES

Siphonaptera:	Neopsylla marleaneae
	N. secura
Ixodoidea:	Boophilus microplus
	Ixodes acutitarsus
Parasitoidea:	Androlaelaps pavlovskii
	Haemogamasus sp.
	Histionyssus latiscutatus
	H. sp.
	Laelaps algericus
	L. traubi
	L. turkestanica
	Macrochelidae
Anoplura:	Hoplopleura pacifica
	H. sicata
	Polyplax sp.

Rattus fulvescens fulvescens (Gray, 1847)

Chestnut Rat

1847. Mus fulvescens Gray. Cat. Hodgson's Coll. B. M. p. 18.
Type locality: Nepal.

1849. Mus caudatior Hodgson. Ann. Mag. Nat. Hist. 3: 203.
Type locality: Nepal.

1859. Mus cinnamomeus Blyth. J. Asiat. Soc. Bengal 28: 294.

Type locality: Schive Gyeng, Burma.

1863. Leggada jerdoni Blyth. J. Asiat. Soc. Bengal 32: 350.

Type locality: Sikkim.

1863. Mus octomammis Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 10.

1891. Mus jerdoni Blanford. The Fauna Brit. India, Mamm. p. 411.

1916. Epimys fulvescens Wroughton. J. Bombay Nat. Hist. Soc. 24(3): 427.

1916. Rattus fulvescens Wroughton. J. Bombay Nat. Hist. Soc. 24(4): 772.

1926. Rattus huang vulpicolor Allen. Amer. Mus. Nov. 217: 14.

Type locality: Namting River, Yunnan-Burma border.

Distribution: Nepal, Darjeeling, Sikkim, Assam, Burma and Yunnan.

Nepal Records: Gray (1846, p. 18; 1863b, p. 10), Hinton and Fry (1923, p. 421), Fry (1925, p. 259), Worth and Shah (1969, p. 127), Abe (1971, p. 412).

NEP: 61 specimens: Mitchell - 51; AVWE - 10.

Habitat: The moist broadleaf and oak-rhododendron forests of the midlands from 1800 to 2700 m.

Field Notes: This species has bright fox orange or nearly ochreous dorsal pelage and a dirty white venter. The individual hairs are slaty at the base with bright fulvous tips. The tail is either bicolored or unicolored, the feet are light brown. The fur is long and is usually mixed with

flattened spines. The unusually long tail averages 140% or more of the head and body length. There are four pairs of mammae, two pectoral and two inguinal.

The occipitonasal length usually exceeds 33 mm, the palate is 15 mm or more in length and the upper tooth row is less than 6.3 mm.

Semi-commensal in habit, these rats were taken only from the central and eastern zones of the midlands. Their diet is varied, feeding on insects and their larvae, grains, seeds, berries and fungi.

There is a definite pre- and post-monsoon breeding peak. Females bear two to three litters annually and the litter size is two to eight. Sexually mature males were collected in June and September. Of the 10 females taken in May, three were lactating, two carried three and six embryos, respectively, and two bore uterine scars. Another female collected in August had six embryos. In November, four lactating females were caught. All specimens less than 170 mm in total length were considered subadults and they made up 21% of the May and 18% of the November catch.

These rats were trapped from stone walls surrounding crops and in livestock shelters. Most (51) were taken from Melumche, Sindu District, the AVWE collected 10 from the eastern midlands. There was a dramatic decrease in the number trapped during monsoons; 1.5% of the total catch of

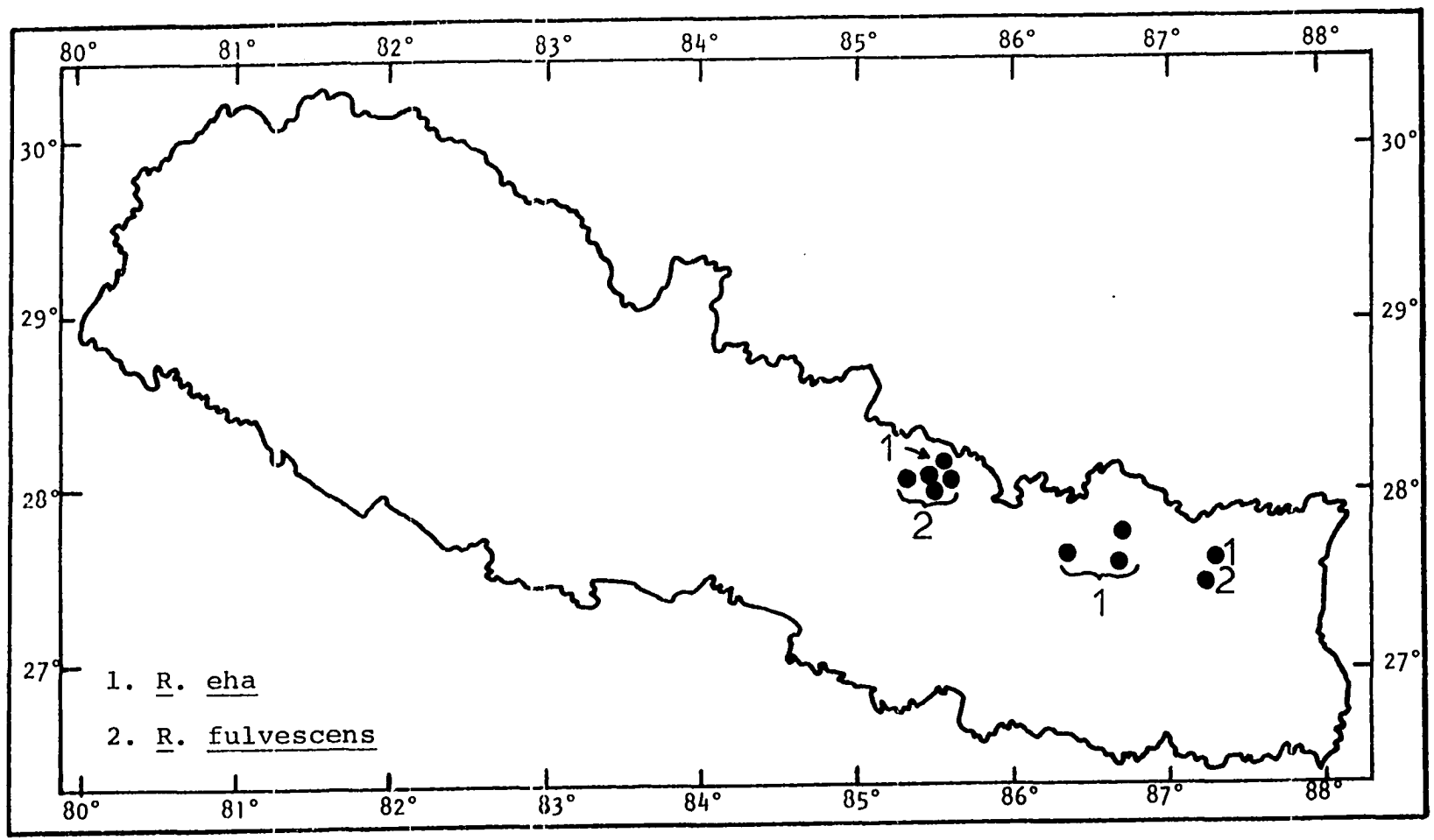


Fig. 45. Collection sites for Rattus eha and R. fulvescens

mammals as compared to 15.2% during pre- and post-monsoon. They were taken in association with R. nitidus, R. niviventer and R. turkestanicus.

ECTOPARASITES

Siphonaptera:	Neopsylla marleaneae
	N. secura
	Nosopsyllus punjabensis
Ixodoidea:	Haemaphysalis aponommoides
	Ixodes lindbergi (="ovatus")
	I. sp.
Parasitoidea:	Haemogamasus nidiformis
	H. suncus
	Hypoaspis sardoa
	Laelaps algericus
	L. traubi
	L. turkestanica
	Myonyssus tuberosus
	Macrochelidae
Anoplura:	Hoplopleura pacifica
	H. sicata

Rattus eha eha (Wroughton, 1916)

Smoke-bellied Rat; Little Himalayan Rat; Spectacled Rat

1916. Epimys eha Wroughton. J. Bombay Nat. Hist. Soc. 24: 428.

Type locality: Lachen, Sikkim.

1925. Rattus eha (Wroughton). J. Bombay Nat. Hist. Soc. 30(2): 529.

Type locality: Sikkim.

Distribution: Nepal and Sikkim.

Nepal Records: Fry (1925, p. 529), Worth and Shah (1969, p. 127), Weigel (1969, p. 150), Abe (1971, p. 411).

NEP: 178 specimens: Mitchell - 119; AVWE - 49; Maser - 10.

Habitat: Subalpine and alpine regions of the central and eastern midlands and the inner Himalayas, from moist forests to alpine meadows; 2700 to 4600 m.

Taxonomic Notes: The "spectacled rat" is a member of the fulvescens group, separated from other species of the group by the black spectacles around the eyes. It differs from R. fulvescens by the smaller body size (Table 13), the occipitonasal length less than 32 mm, the length of the palate less than 15 mm, the supraorbital ridges proportionately weaker and the difference in habitat preference.

Table 13. Comparison of skin measurements of Rattus eha with those of R. fulvescens (in mm).

	Rattus eha (40)	Rattus fulvescens (22)
Total length	252.7 - 280.5	282.4 - 320.8
Tail	151.1 - 189.4	144.4 - 203.1
Hind foot	20.6 - 25.5	24.8 - 30.7
Ear	18.2 - 21.7	20.6 - 23.8

Field Notes: The pelage is brownish red above and light gray to blue gray below, the feet brown. The fur is soft and very thick. The long tail, roughly 160% of the head and body length, is distinctly bicolored, dark brown above and whitish below. Four pairs of mammae are present.

These rodents are strictly feral, being trapped from boulder heaps and stone walls surrounding pastures and buckwheat fields. Their diet consists of insects, seeds, grasses and other plant material.

Peak breeding activity is exhibited in May and June and in September and October. Up to three litters are produced annually and the litter size is three to seven. Two females bearing three and seven embryos were collected in September. Of 35 females examined in October, five were lactating and six bore uterine scars. Of 58 males collected during the same period, none had enlarged testes. The October catch of 95 specimens contained only two which were immatures. Their breeding season does not extend into November as with the commensal forms of the genus.

Most of the specimens were collected from the eastern midlands and inner Himalayas (Khumjung - 66; Lukla - 13; Thodung - 29) with a small number taken from the central midlands (Langtang - 10; Dhukphu - 1). None were collected below 2700 m. Rattus turkestanicus was the only other rat collected in conjunction with this species.

ECTOPARASITES

Siphonaptera:	*Frontopsylla spadix*
	Neopsylla mantissa
	N. marleaneae
	N. pagea
	N. secura
	N. stevensi
	Palaeopsylla helenae
	P. tauberi
	Paradoxopsyllus hollandi
	Stenischia n. sp.
	Stenoponia n. sp.
Ixodoidea:	*Haemaphysalis aborensis*
	H. aponommoides
	H. bispinosa
	Ixodes lindbergi (="*ovatus*")
	I. sp. 1
	I. sp. 2
	I. sp. A
	I. sp. B
Parasitoidea:	*Haemogamasus citelli*
	H. nidiformis
	H. oliviformis
	Laelaps algericus
	L. traubi
	L. turkestanica
	Myonyssus tuberosus
Anoplura:	*Hoplopleura oenomydis*
	H. pacifica
	H. sicata
	H. dissicula
	H. sp.

Mus musculus ssp. Linnaeus, 1758

Distribution: Mustang District of Nepal.

NEP: 30 specimens: Mitchell - 30.

Habitat: The alpine desert region of the Mustang District (2700 m).

Field Notes: Thirty specimens of a feral mouse were collected from the Mustang District. It is similar in body size and cranial characters to Mus musculus homourus, but differs in color, ecology and habitat preference.

The dorsal pelage is grayish brown and the venter grayish yellow. The fur is thick and long, the tail is bi-colored. The number of mammae is 10.

These mice were caught from stone walls, prostrate clumps of vegetation and burrows beneath tree roots. As they were collected during February and March, no reproductive information was recorded. The diet probably consists of wheat, seeds and grasses. The stomach contents of five specimens contained starchy material and plant matter.

C. O. Maser collected a series of Mus musculus ssp. from Phulung Ghyang, Nuwakot District. These mice were probably M. m. homourus or M. m. urbanus. As well, the AVWE took four specimens of a house mouse from the eastern midlands. Ectoparasite data from the three collections of Mus musculus ssp. have been combined.

ECTOPARASITES

Siphonaptera:
Citellophilus mygala
Ctenophyllus n. sp.
Hystrichopsylla n. sp.
Neopsylla marleaneae
N. pagea
N. secura
Nosopsyllus punjabensis
Palaeopsylla tauberi

	Rhadinopsylla n. sp.
	Stenoponia n. sp.
	Evansipsylla thysanota
Ixodoidea:	*Haemaphysalis aponommoides*
	H. sp.
	Ixodes acutitarsus
	I. sp. A
Parasitoidea:	*Androlaelaps fahrenholzi*
	A. pavlovskii
	Cheyletus sp.
	Eucheyletia sinensis
	Haemogamasus nidiformis
	H. suncus
	Histionyssus sp.
	H. suncus
	Laelaps algericus
	L. traubi
	L. turkestanica
	Ornithonyssus bacoti
	Macrocheles sp.
Listrophoroidea:	Listrophoridae
Anoplura:	*Hoplopleura acanthopus*
	H. capitosa
	H. pacifica

Mus musculus homourus (Hodgson, 1845)

Himalayan House Mouse

1841. *Musculus nipalensis* Hodgson. J. Asiat. Soc. Bengal 10: 915. (*nom. nud.*)

Type locality: Nepal.

1845. *Mus homoourus* Hodgson. Ann. Mag. Nat. Hist. 15: 268.

Type locality: Nepal.

1846. *Mus nipalensis* Gray. Cat. Hodgson's Coll. B. M. p. 19.

Type locality: Nepal.

1849. Mus darjilingensis Hodgson. Ann. Mag. Nat. Hist. 3: 203.

Type locality: Darjeeling.

1867. Mus homourus Jerdon. The Mamm. of India. p. 204.

1878. Mus kakhyensis Anderson. Zool. Researches Western Yunnan. p. 307.

Type locality: Ponsee, Kakhyen Hills, Western Yunnan, China.

1927. Mus bactrianus tantillus Allen. Amer. Mus. Nov. 270: 9.

Type locality: Wanhsien, Szechuan, China.

1955. Mus musculus pygmaeus Biswas and Khajuria. Proc. Zool. Soc. Calcutta 8(1): 28. (new syn.)

Type locality: Pangboche, Imje Valley, Solukhumbu, Nepal.

Distribution: Nepal, Darjeeling, probably Sikkim and the Bhutan Duars, Szechuan, Yunnan, Southern China.

Nepal Records: Hodgson (1841e, p. 915; 1845, p. 268), Gray (1846, p. 19), Fry (1925, p. 529), Biswas and Khajuria (1955, p. 28), Worth and Shah (1969, p. 127), Weigel (1969, p. 164).

NEP: 558 specimens: Mitchell - 558.

Habitat: The Mahabharat Lekh and midlands from 1300 to 3000 m; also the eastern inner Himalayas, up to 4200 m.

Taxonomic Notes: Mus musculus homourus differs little from M. m. urbanus. Thomas (1881) considered that there was a habitat difference between the two; M. m. homourus being from the Himalayan region and M. m. urbanus from the plains.

Ellerman's (1961b) comparison of five cranial measurements showed little difference between the two groups.

Field Notes: The Himalayan house mouse is medium sized; it varies in color from light to dark brown dorsally and pale to ash gray ventrally. The fur is short and without spines. The nearly naked tail is uniform dark brown throughout. Five pairs of mammae are present, three pectoral and two inguinal.

The rostrum of the skull is very short and the supraorbital ridges are divergent. The interparietals are large and the incisive foramina are long. The occipitonasal length is usually 18 to 21 mm. The upper incisors are narrow and yellow in color. There is often a subapical notch formed on the outer side of the cutting edge of the incisor immediately behind the margin of enamel.

These mice are omnivorous, feeding chiefly on grain and seeds. Stomach contents indicate that they also consume animal matter, mostly insects. They do considerable damage to the wheat crop by gnawing off entire grain heads.

A summer nest is built among the rock walls. In May, 1969, seven nests were excavated from these walls. They consisted of varied fibrous plant material lined with fine grasses.

According to Blanford (1891), this species breeds three to five times a year and has four to eight young per

litter. Our field data suggest that breeding occurs two to three times a year with pre- and post-monsoon peaks. Lactating females and those bearing uterine scars were collected from early February through May. Four females with embryos were taken, two in April and two in May. Both females in April had six embryos, both in May, five. Any specimens having a total length less than 110 mm were considered immatures. Immatures made up 28.7% of the pre-monsoon catch and 16.9% of the post-monsoon catch, but during monsoons they made up less than 6% of the catch.

Chiefly commensal, these mice were collected from houses, grist mills, livestock compounds and stone walls surrounding fields. As altitudes increase they live in closer contact with man. Mus musculus homourus represented about 12% of the total number of mammals collected from Nepal. They were trapped from temperate, subalpine and alpine biotopes. A disproportionate number of males to females was taken, 378 males: 146 females.

ECTOPARASITES

Siphonaptera:
Ctenophyllus n. sp.
Frontopsylla spadix
Neopsylla mantissa
N. marleaneae
N. secura
Nosopsyllus punjabensis
Palaeopsylla helenae
P. remota
P. tauberi
Paradoxopsyllus acanthus

P. hollandi
P. mustangensis
Stenischia n. sp.
Xenodaeria telios

Ixodoidea: Haemaphysalis aponommoides
H. indica
H. montgomeryi
H. warburtoni
H. wellingtoni
Ixodes acutitarsus
I. himalayensis
I. lindbergi (="ovatus")
I. sp. 1
I. sp. 2
I. sp. A
I. sp. B
I. sp. facies
Rhipicephalus haemaphysaloides

Parasitoidea: Androlaelaps pavlovskii
A. soricinus
Eulaelaps stabularis
Haemogamasus citelli
H. nidiformis
H. suncus
Histionyssus sp.
Hypoaspis sp.
H. lubrica
H. sardoa
Laelaps sp.
L. algericus
L. nuttalli
L. traubi
L. turkestanica
Spinturnex sp.
Macrochelidae

Uropodoidea: Uropodina sp.

Anoplura: Hoplopleura capitosa
H. sicata

Mus musculus urbanus Hodgson, 1845

Nepal House Mouse

1845. Mus urbanus Hodgson. Ann. Mag. Nat. Hist. 15: 269.

Type locality: Kathmandu, Nepal.

1845. Mus dubius Hodgson. Ann. Mag. Nat. Hist. 15: 268.

Type locality: Nepal.

1878. Mus viculorum Anderson. Zool. Researches West. Yunnan. 308.

Type locality: Ponsee, western Yunnan.

Distribution: Nepal, possibly Sikkim and Bhutan, western Yunnan.

Nepal Records: Hodgson (1845, pp. 268-269), Gray (1846, p. 10), Hinton and Fry (1923, p. 422), Fry (1925, p. 529), Worth and Shah (1969, p. 127), Weigel (1969, p. 164).

NEP: 540 specimens: Mitchell - 540.

Habitat: The temperate, subalpine and alpine biotopes of the midlands and inner Himalayas, from 1500 to 4200 m.

Field Notes: Mus musculus urbanus is similar in distribution, cranial characters and biology to M. m. homourus, but differs in overall body measurements. Dorsally the color is from dark to light brown, ventrally it is ochreous, tawny or bluish gray. The tail is not distinctly bicolored, but is paler underneath. The feet are buffy or drab and the toes are white. Five pairs of mammae are present. The occipitonasal length ranges from 19 to 23 mm and the upper tooth row is less than 3.8 mm.

These mice were frequently trapped inside houses, although in summer they were taken from stone fences, rock

piles and grist mills. Omnivorous in habits, they feed on grains, seeds, berries and insects. They do extensive damage to crops and stored goods. Entire heads of wheat were recovered from their summer nests.

There are two peaks of breeding activity: May to June and October to mid-November. These mice produce three to four litters annually and the litter size is three to eight. Over 43% of the adults collected during the May-June period exhibited signs of breeding activity: 14.5% of the males had enlarged testes; 37.4% of the females possessed embryos; 21.7% bore uterine scars and 14.1% were lactating. Immatures made up approximately 8.5% of the catch. For the October-November period, the following reproductive information was recorded: 15% of the males exhibited enlarged testes; 8.6% of the females had embryos; 31% were lactating and 21.2% bore uterine scars. Forty-one females examined yielded a total of 248 embryos, an average of 6.05 embryos per female (Fig. 46a).

ECTOPARASITES

Siphonaptera:
- Citellophilus mygala
- Hystrichopsylla n. sp.
- Neopsylla marleaneae
- N. secura
- Nosopsyllus punjabensis
- Palaeopsylla helenae
- P. tauberi
- Stenischia n. sp.
- Xenodaeria telios

Ixodoidea:
- Haemaphysalis canestrinii

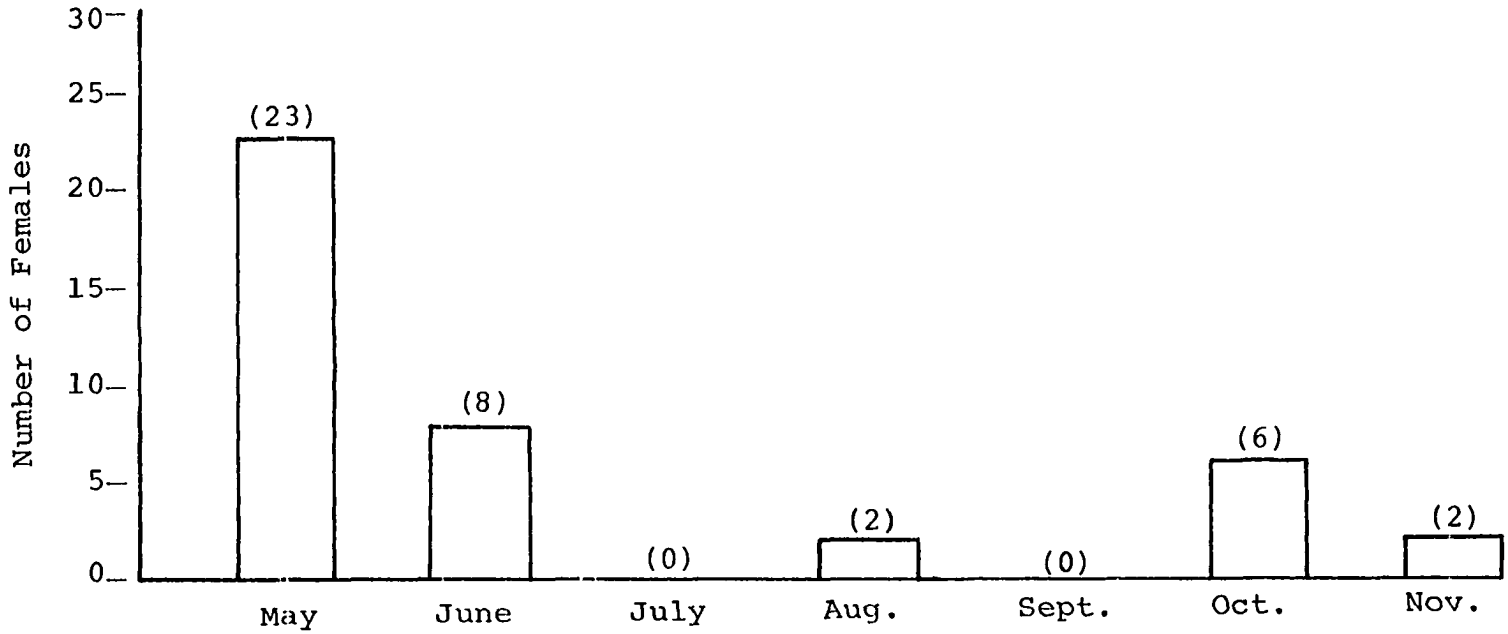


Fig. 46a. Number of pregnant Mus musculus urbanus collected by month from 1967-1970.

H. montgomeryi
Ixodes mitchelli
I. lindbergi (="ovatus")
I. shahi
I. sp. 1
I. sp. 2
I. sp. A
I. sp. B
Rhipicephalus haemaphysaloides
Rhipicephalus sp.

Parasitoidea: Androlaelaps hermaphrodita
A. pavlovskii
Cheyletus sp.
Eulaelaps stabularis
Haemogamasus citelli
H. suncus
Histionyssus sp.
H. latiscutatus
Hypoaspis sp.
H. sardoa
Laelaps sp.
L. algericus
L. nuttalli
L. turkestanica
Ascidae
Macrochelidae
Parasitidae

Uropodoidea: Uropodina sp.

Anoplura: Hoplopleura capitosa
Polyplax stephensi

Mus booduga booduga (Gray, 1837)

Little Indian Field Mouse

1837. Leggada booduga Gray. Charlesworths Mag. Nat. Hist. 1: 586.

Type locality: Southern Mahratta country, India.

1839. Mus lepidus Elliot. Madras. J. Litt. Sci. 10: 216.

Type locality: Southern Mahratta country.

1851. Mus terricolor Blyth. J. Asiat. Soc. Bengal 20: 172.

Type locality: Southern India.

1852. Mus fulvidiventris Blyth. J. Asiat. Soc. Bengal 21: 349.

Type locality: Near Calcutta.

1866. Mus beavanii Peters. Proc. Zool. Soc. London 21: 559.

Type locality: Manbhoum, India.

1867. Leggada lepida Jerdon. The Mamm. of India. p. 209.

1881. Mus (Leggada) buduga Thomas. Proc. Zool. Soc. London. p. 553.

1891. Mus buduga Blanford. The Fauna Brit. India, Mamm. p. 416.

1912. Leggada dunni Wroughton. J. Bombay Nat. Hist. Soc. 21: 339.

Type locality: Ambala, Punjab.

1947. Mus booduga booduga (Gray), in Ellerman. J. Mammal. 28(4): 383.

Distribution: Nepal Terai, Continental India south of the Ganges and Indus Rivers and Sri Lanka.

Nepal Records: Chesemore (1970, p. 164).

NEP: 42 specimens: Mitchell - 42.

Habitat: Cultivated fields, scrub jungle and sometimes houses in the Terai.

Taxonomic Notes: Ellerman (1961b) contended that the specific difference between the Mus booduga type of Leggada and the M. musculus type is average, not absolute. He stated that it is hard to see how Leggada could be used as a

genus and placed booduga in the genus Mus.

Field Notes: Mus booduga is a small field mouse with a tail approximately equal to the head and body length. The fur is usually without spines. Dorsally the color is a sandy or light brown and ventrally it is whitish or dull gray. The tail is bicolored and the feet are dull white. There are five pairs of mammae, three pectoral and two inguinal.

The skull is without clear supraorbital ridges, the rostrum is slightly longer than in M. musculus and the teeth are somewhat specialized (M_1 distorted and M_3 reduced). The occipitonasal length is usually less than 20 mm. The palate most often exceeds 50% of the occipitonasal length.

In the Terai, these mice are commonly found around fields of rice and mustard, living in burrows or under roots and stones. Their diets consist chiefly of cereal grains and grass seeds.

Two to three litters are produced annually and the litter size is three to seven young. Over 55% of those caught in April showed signs of breeding activity: 50% of the males had enlarged testes and 60% of the females were either lactating or bore embryos. On 3 April, a female collected contained four embryos that averaged 4.1 mm in length.

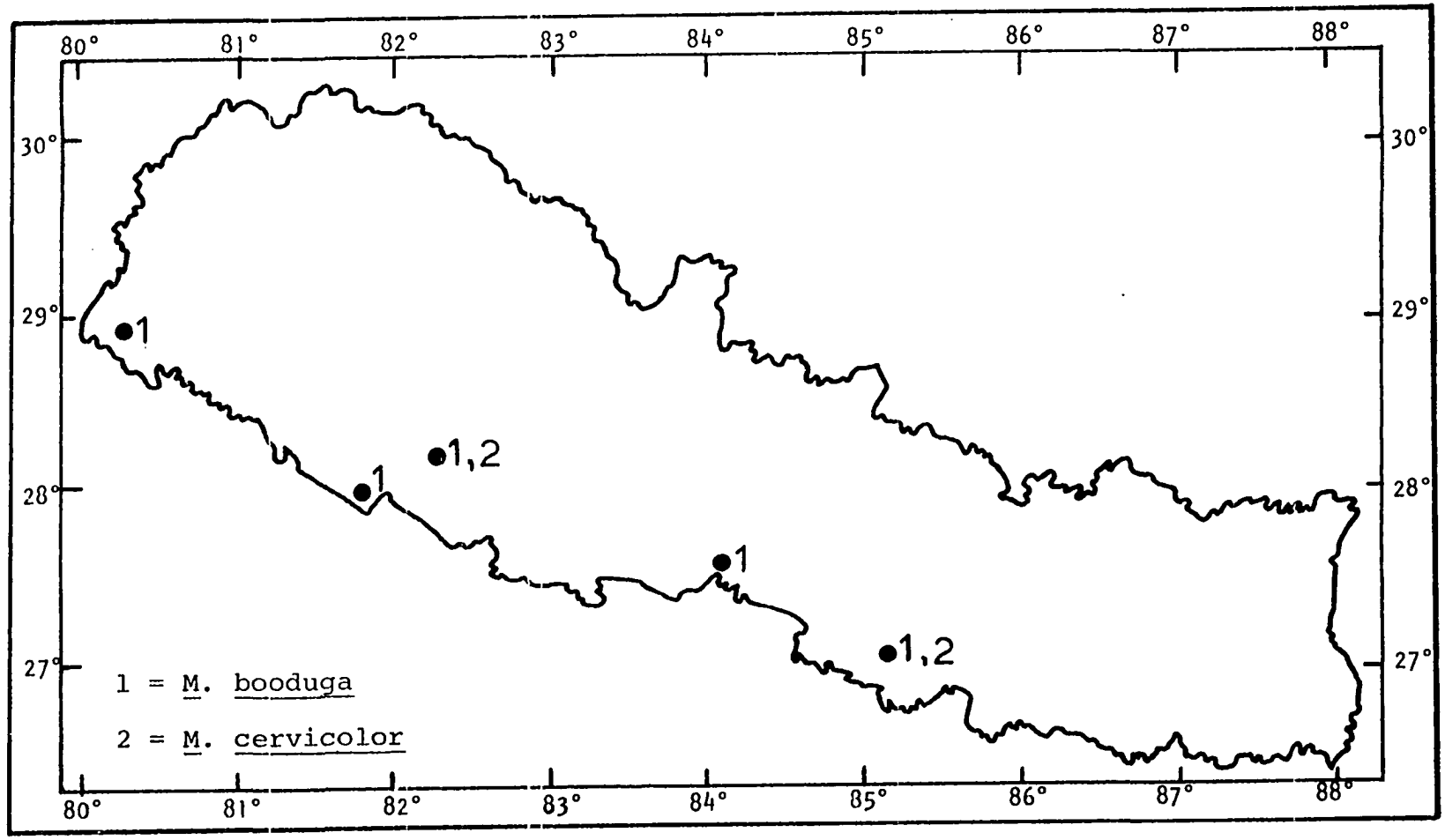


Fig. 46b. Collection sites for Mus booduga and M. cervicolor

ECTOPARASITES

Siphonaptera: Acropsylla episema

Ixodoidea: Haemaphysalis bispinosa

Parasitoidea: Androlaelaps hermaphrodita
Laelaps algericus
L. nuttalli
L. sp.

Mus cervicolor cervicolor Hodgson, 1845

Fawn-colored Mouse

1845. Mus cervicolor Hodgson. Ann. Mag. Nat. Hist. 15: 268.

Type locality: Nepal.

1845. Mus strophiatus Hodgson. Ann. Mag. Nat. Hist. 15: 268.

Type locality: Nepal.

1855. Mus cunicularis Blyth. J. Asiat. Soc. Bengal 24: 721.

Type locality: Cherrapunji, Khasi Hills, Assam.

1920. Leggada cervicolor Wroughton. J. Bombay Nat. Hist. Soc. 27: 959.

Type locality: Nepal.

Distribution: Nepal and Assam.

Nepal Records: Hodgson (1845, p. 268), Gray (1846, p. 19), Hinton and Fry (1923, p. 422), Worth and Shah (1969, p. 127), Abe (1971, p. 408).

NEP: 5 specimens: Mitchell - 4; AVWE - 1.

Habitat: Cultivated areas of the Terai and duns to lower elevations in the Mahabharats (1500 m).

Field Notes: Mus cervicolor is a medium-sized mouse that has a tail length equal to or a little longer than the head and body. It is dark fawn or rufous brown above and white underneath, with pale white feet and a bicolored tail. There are 10 mammae, three pairs pectoral and two inguinal.

The occipitonasal length usually does not exceed 23 mm. The palatal foramina usually exceed 23% of the occipitonasal length. The upper incisors have the subapical notch and M_3 is very small.

These mice are found in the eastern Terai and foothills where they inhabit scrub jungle and live in burrows and crevices around fields of rice and wheat. The food habits and reproductive biology are probably similar to those of other murids in the area. In April and May, Abe (1971) collected a pregnant female and six others bearing uterine scars. Based upon his information, the litter size ranges from four to eight. He also collected two males with enlarged testes.

According to Thomas (1881), Hodgson found this species abundant in cultivated fields of the Kathmandu Valley. Specimens were collected by the NEP from the eastern Terai and the Dang Dun and the AVWE took a single specimen from Kasuwa Khola, Sankhuwasabha District (1660 m). Maser trapped extensively in 1966 and 1967 throughout the Kathmandu Valley without securing any specimens, but Abe (1971) took a large

number from both the Kathmandu and the Pokhara Valleys.

ECTOPARASITES

Parasitoidea: Laelaps sp.
L. algericus
L. nuttalli

Mus platythrix gurkha (Thomas, 1914)

Indian Brown Spiny Mouse

1914. Leggadilla gurkha Thomas. J. Bombay Nat. Hist. Soc. 23(2): 200.

Type locality: Jerna, Ramnagar, Kumaon.

1941. Mus gurkha (Thomas), in Ellerman. Families and Genera of Living Rodents. Vol. 2, p. 254.

1947. Mus platythrix gurkha (Thomas), in Ellerman. J. Mammal. 28(3): 385.

Distribution: West Nepal, Kumaon, northern India.

NEP: 5 specimens: Mitchell - 5.

Habitat: Near cultivated fields in the Dang Valley at 790 m.

Taxonomic Notes: Some authors split the genus Mus into several genera such as Leggada and Leggadilla. Thomas (1914) based the genus Leggadilla on forms that have supra-orbital ridges. Ellerman (1961b) refuted this premise by stating that it is impossible to distinguish Leggadilla from many specimens assigned to Leggada or Mus which may also have supraorbital ridges. Ellerman (1941) placed

Leggadilla gurkha in the Mus platythrix group, retaining Leggadilla as a subgenus.

Field Notes: Mus platythrix is a large mouse and in most specimens the head and body length usually exceeds 100 mm. The tail is short, averaging 80% of the head and body length. The fur is soft with flat guard hairs that tend to be spiny. The pelage is fawn colored above and white ventrally. The separation of the two colors is well defined. The mammary formula is three pairs pectoral and two abdominal.

The occipitonasal length is 23 to 28 mm and the interparietals are well developed. The palate length normally exceeds half of the occipitonasal length. M_1 is usually larger than M_2 and M_3 combined.

Spiny mice live in burrows excavated in the sides of stream banks or rice paddies. Prater (1965) stated that they close their burrow entrances with small pebbles. The food consists of grain, seeds and vegetable matter. According to Jerdon (1867), they are monogamous and nocturnal in habit.

In April, 1968, five specimens were trapped from Darakhuti, Dang Valley, representing the first collection of Mus platythrix gurkha from Nepal. This extended their known range to 82° 17' E longitude from a previous limit of 79° 39' E.

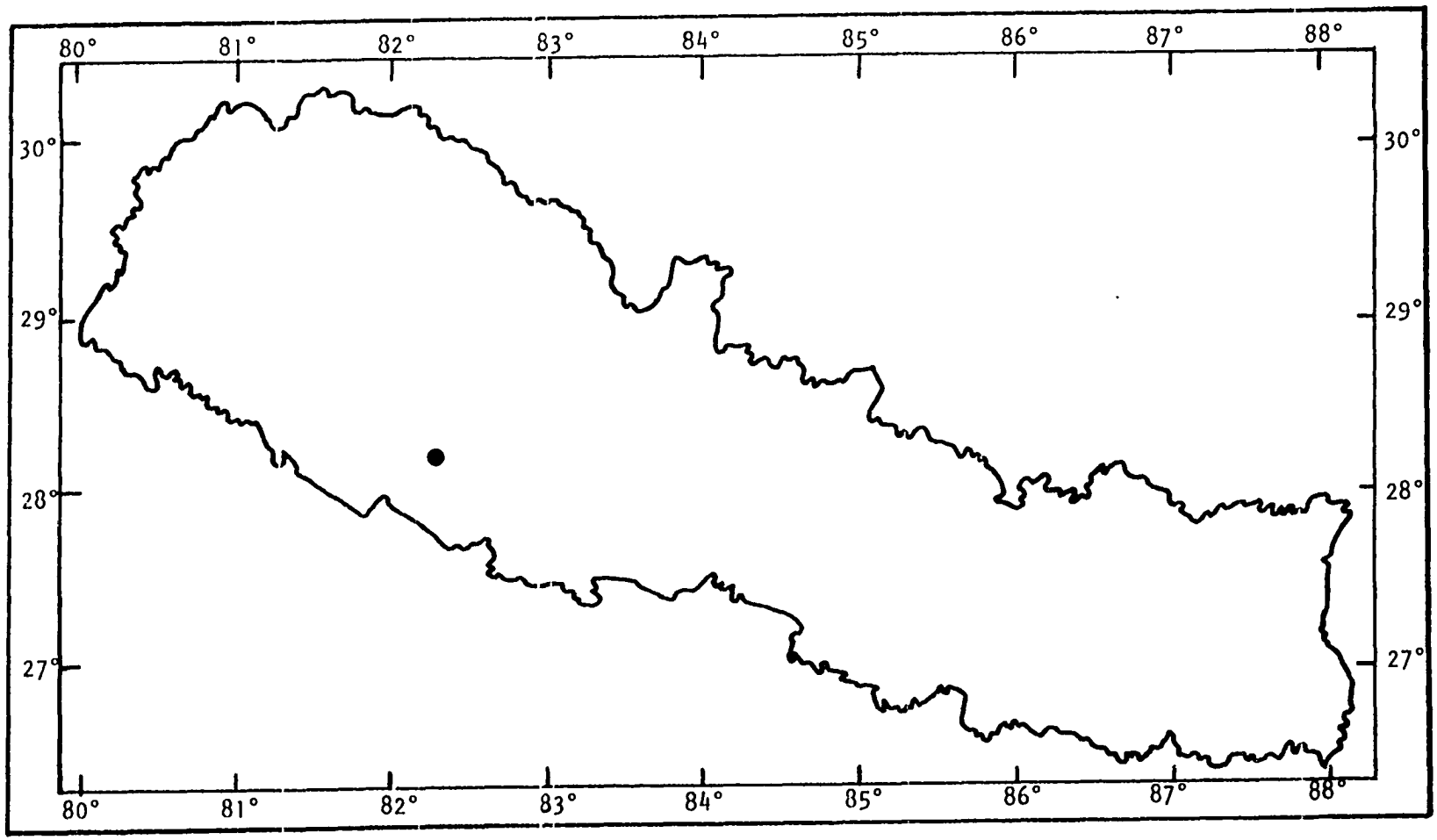


Fig. 47. Collection site for Mus platythrix gurkha

ECTOPARASITES

Parasitoidea: Laelaps algericus
L. echidnina

Golunda ellioti myothrix (Hodgson, 1845)

Indian Bush Rat

1845. Mus myothrix Hodgson. Ann. Mag. Nat. Hist. 15: 267

Type locality: Kahulia Powa, Nepal.

1891. Golunda ellioti Blanford. The Fauna Brit. India, Mamm. p. 427.

1923. Golunda ellioti myothrix (Hodgson), in Thomas. J. Bombay Nat. Hist. Soc. 29(2): 376.

Type locality: Kangra District, northern India.

Distribution: Nepal midlands and Terai, Kumaon, Punjab.

Nepal Records: Hodgson (1845, p. 267), Gray (1846, p. 18), Hinton and Fry (1923, p. 422).

NEP: 3 specimens: Mitchell - 3.

Habitat: Thick bush and scrub jungle of the Terai and midlands, from 100 to 2500 m.

Field Notes: The bush rat is thick-set and vole-like in appearance. The pelage consists of thick, soft fur with long spiny guard hairs. The tail is shorter than the head and body and is stout at the base, tapering apically. The back is yellowish brown and the belly is brownish white or gray. The tail is dark brown above and pale below. Four pairs of mammae are present, two pectoral and two inguinal.

This rat is characterized by a peculiar type of dentition. The upper incisors are broad and prominently grooved. The cusps of the upper molars are enlarged and raised, particularly in the center and inner rows. This peculiar pattern is composed of semicircular lobes arranged in a triple row in the upper molars (Fig. 48) and a double row in the lower molars.

The habitats of these rats are dense undergrowth and scrub jungle. According to Prater (1965), they build a densely woven nest of stalks and grasses in thick brush. The diet consists of roots, grass stems and seeds. Little is known about the breeding habits, but Walker et al. (1964b) gave the litter size as three to four.

Two specimens were taken from the Terai (150 m) and one from the central midlands (2430 m). Gray (1846) listed the central and northern hilly regions of Nepal as the collection sites for Hodgson's specimens.

ECTOPARASITES

Siphonaptera:	Xenopsylla astia
Ixodoidea:	Haemaphysalis montgomeryi Rhipicephalus haemaphysaloides
Parasitoidea:	Laelaps sp.

Bandicota bengalensis bengalensis (Gray and Hardwicke, 1835)

Lesser Bandicooot Rat, Indian Mole Rat

1835. Arvicola bengalensis Gray and Hardwicke. Illust. Ind. Zool. 2: pl. 21.

Type locality: Bengal.

1846. Nesokia hydrophila Gray. Cat. Hodgson's Coll. B. M. p. 19.

Type locality: Nepal.

1855. Mus tarayensis Horsfield. Ann. Mag. Nat. Hist. 16: 112.

Type locality: Nepal.

1855. Mus plurimammis Horsfield. Ann. Mag. Nat. Hist. 16: 112.

Type locality: Nepal.

1855. Mus morungensis Horsfield. Ann. Mag. Nat. Hist. 16: 112.

Type locality: Nepal.

1878. Mus (Nesokia) blythianus Anderson. J. Asiat. Soc. Bengal 47(2): 227.

Type locality: Bengal.

1878. Mus (Nesokia) barclayanus Anderson. J. Asiat. Soc. Bengal 47(2): 229.

Type locality: Guna, central India.

1891. Nesocia bengalensis Blanford. The Fauna Brit. India, Mamm. p. 423.

1891. Nesocia nemorivaga Blanford. The Fauna Brit. India, Mamm. p. 426.

1908. Bandicota nemorivaga Wroughton. J. Bombay Nat. Hist. Soc. 18: 752.

Type locality: Central and northern regions of Nepal.

Fig. 48. Upper molars of Golunda ellioti myothrix

A. Upper tooth row (15X)
B. Molar one (M_1 - 30X)


A
B

1923. Gunomys bengalensis (Gray and Hardwicke), in Hinton and Fry. J. Bombay Nat. Hist. Soc. 29(2): 420.

Distribution: Burma, Assam, Bhutan Duars, Sikkim, West Bengal, Nepal.

Nepal Records: Hodgson (1836c, p. 234; 1845, p. 266-268), Gray (1846, p. 19), Horsfield (1855, p. 112), Hinton and Fry (1923, p. 419), Fry (1925, p. 528), Worth and Shah (1969, p. 127), Chesemore (1970, p. 164), Abe (1971, p. 419).

NEP: 4 specimens: Mitchell - 4.

Habitat: Damp alluvial tracts and cultivated areas of the Terai and duns.

Taxonomic Notes: Blanford (1891) listed three separate species of bandicoot rats: Nesocia bengalensis - the Indian mole rat, Nesocia bandicota - the bandicoot rat and Nesocia nemorivaga - the smaller bandicoot rat. According to more recent literature (Ellerman and Morrison-Scott 1966; Marshall 1969; Prater 1965; Walker et al. 1964b), the genus consists of two species, B. bengalensis and B. indica.

Field Notes: The bandicoot rat is a large, stoutly built murid. The scaly, nearly naked tail is shorter than the head and body. The texture of the pelage is harsh. The color ranges from light gray to dark blackish brown. The feet have six plantar pads and the toes, except the pollex of the forefeet, are provided with strong, straight claws. The mammae are 12 in number, three pairs pectoral and three

abdominal. Measurements of four specimens are: Head and body - 278.1 to 291.9 mm; tail - 173.6 to 222.1 mm; hind foot - 39.2 to 45.0 mm; ear - 23.9 to 30.2 mm. This rat weighs up to 250 gm.

Good diggers, bandicoot rats construct elaborate burrows. Their presence in the Terai can be recognized by the piles of earth resembling large mole-hills at each burrow opening. According to Walker et al. (1964b), each burrow is evidently inhabited by a single animal.

Lesser bandicoots feed on stored grains, field crops and fruits; they have been seen feeding on grass and grass roots. Belligerent when irritated, they erect their manes and utter a grunting sound. According to Walker et al. (1964b), they breed continuously throughout the year and have litters of 10 to 12.

Many galleries and mounds of bandicoot rats were seen in the earthen floors of granaries at Gulari, Bara District. On 26 March, 1970, three specimens were caught with #4 rat traps. These rats are eaten by the Taroo natives of the Terai.

ECTOPARASITES

None.

Bandicota indica nemorivaga (Hodgson, 1836)

Large Bandicoot Rat

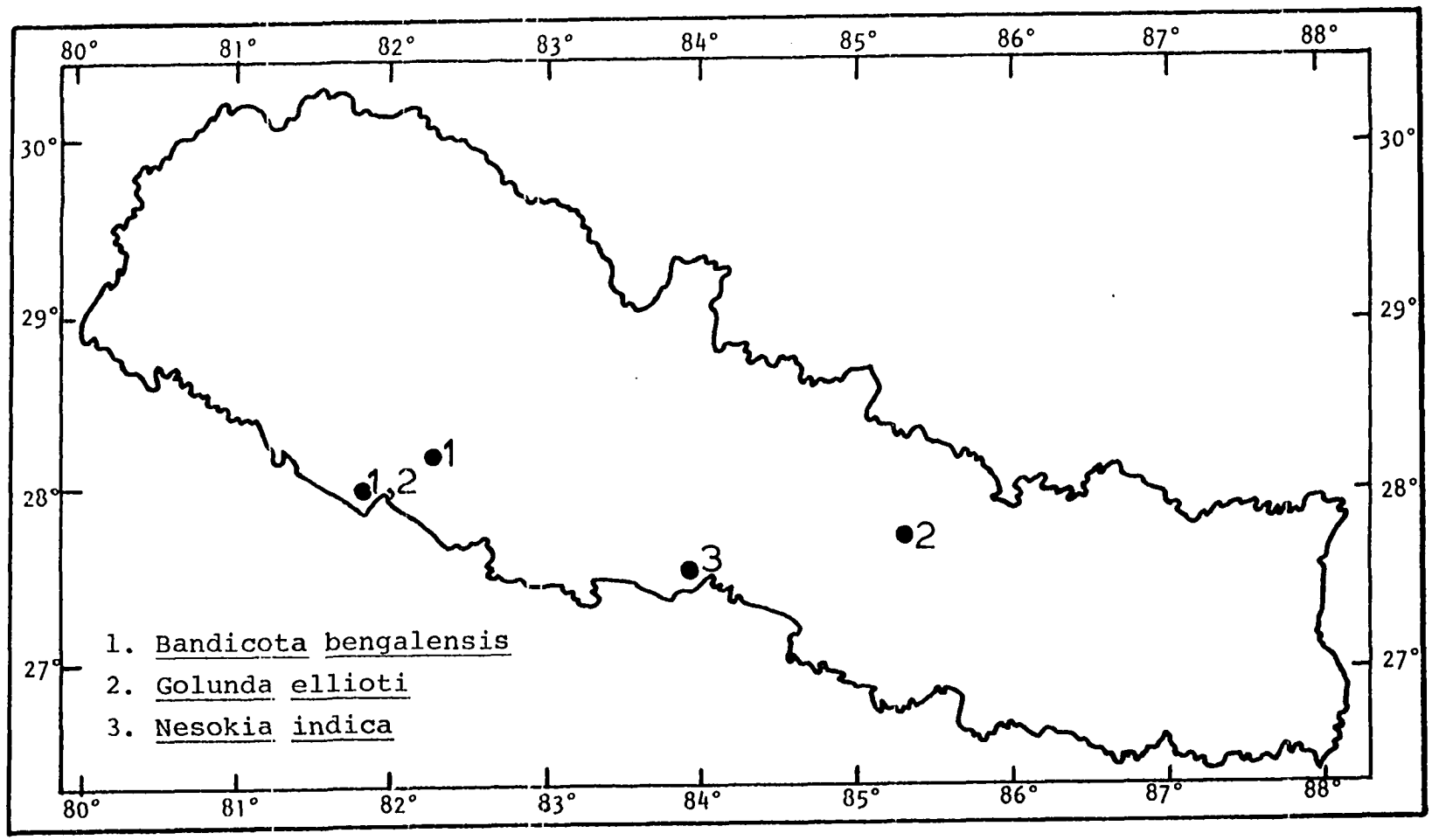


Fig. 49. Collection sites for other Murinae

1836. Mus (Rattus) nemorivagus Hodgson. J. Asiat. Soc. Bengal 5: 234.

Type locality: Nepal.

1845. Mus nemorivagus Hodgson. Ann. Mag. Nat. Hist. 15: 266.

Type locality: Central region of Nepal.

1867. Mus bandicoota Jerdon. The Mamm. of India. p. 193

1878. Mus (Nesokia) elliotanus Anderson. J. Asiat. Soc. Bengal 46(4): 231.

Type locality: Calcutta.

1881. Mus (Nesokia) bandicota Thomas. Proc. Zool. Soc. London. p. 528.

1891. Nesocia bandicota Blanford. The Fauna Brit. India, Mamm. p. 425.

1916. Bandicota mordax Thomas. J. Bombay Nat. Hist. Soc. 24(4): 642.

Type locality: Chiengmai, northern Thailand.

1941. Nesokia nemorivaga taiwanus Tokuda. Biogeog. Tokyo 4(1): 74.

Type locality: Taihoka, Formosa.

1941. Bandicota nemorivaga nemorivaga (Hodgson), in Ellerman. Families and Genera of Living Rodents. Vol. 1, p. 280.

Distribution: Taiwan, southeast Asia, Burma, West Bengal, Nepal, probably central India.

Nepal Records: Hodgson (1836c, p. 234; 1845, p. 266), Gray (1846, p. 17), Chesemore (1970, p. 17), Abe (1971, p. 420).

Habitat: Cultivated fields of the Terai and the Rapti Dun, also the Kathmandu Valley; 300 to 1500 m.

Field Notes: The large bandicoot rat is much larger than the lesser bandicoot rat. The coat is harsh with a mane of coarse black hairs concentrated along the middle of the back. When irritated, it erects this mane. The color of the upper parts ranges from light gray to various shades of brown or almost black. The tail is scaly and scantily haired. The front claws are large. There are 12 mammae, three pairs pectoral and three pelvic. The head and body length is 300 to 360 mm, the tail length 230 to 285 mm, the hind foot 45 to 50 mm and the weight 600 to 700 gm.

The skull is very large with large, broad upper incisors, = +4 mm in combined width (Marshall 1969). The nasals are very long (more than 35% of the occipitonasal length) and the occipitonasal length is 46 to 68 mm. The auditory bullae are well developed and inflated.

Bandicoots are fossorial, burrowing into canal banks and rice paddies. Omnivorous, they feed on grain, vegetables and household refuse. These rats are destructive to cereal grains as well as root crops. They breed throughout the year and produce litters of 10 to 12 (Walker et al. 1964b). Abe (1971) collected a female that bore 13 uterine scars.

ECTOPARASITES

None.

Nesokia indica indica (Gray and Hardwicke, 1832)

Short-tailed Bandicoot Rat (Short-tailed Mole Rat)

1832. Arvicola indica Gray and Hardwicke. Illustr. Ind. Zool. 1: pl. XI.

Type locality: India.

1837. Mus hardwickei Gray. Charlesworths Mag. Nat. Hist. 1: 585.

1842. Nesokia hardwickii Gray. Ann. Mag. Nat. Hist. 10: 265.

Type locality: India.

1845. Mus pyctoris Hodgson. Ann. Mag. Nat. Hist. 15: 267.

Type locality: Central region of Nepal.

1851. Nesokia griffithi Horsfield. Cat. Mamm. Ind. Mus. p. 145.

Type locality: Pushut, northwest Frontier, India.

1860. Spalacomys indicus Peters. Abh. K. Akad. Wiss. Berlin. p. 143.

Type locality: Eastern India.

1867. Nesokia indica Jerdon. The Mamm. of India. p. 187.

1867. Nesokia hardwickei Jerdon. The Mamm. of India. p. 190.

1878. Mus (Nesokia) hardwickii Anderson. J. Asiat. Soc. Bengal 47(2): 221.

Type locality: Sind and Punjab.

1891. Nesocia hardwickei Blanford. The Fauna Brit. India, Mamm. p. 422.

1907. Nesokia bailwardi Thomas. Ann. Mag. Nat. Hist. 20: 199.

Type locality: Bunder-i-gaz, south shore Caspian Sea, Persia.

1908. Nesokia beaba Wroughton. J. Bombay Nat. Hist. Soc. 18: 741.

Type locality: Pithoro, central Sind Desert.

Distribution: Saudi Arabia, Egypt, Turkmen plains, southwestern Caspian coastal plain, Afghanistan, Sind, Punjab, Northwest Frontier, central India, Nepal Terai.

Nepal Records: Hodgson (1845, p. 267), Gray (1846, p. 17), Weigel (1969, p. 150).

NEP: 3 specimens: Mitchell - 3.

Habitat: Grasslands of the Rapti Dun and Terai.

Field Notes: The mole rat is rather heavily built with short, harsh fur. The tail is short, nearly naked and less than three-quarters of the head and body length. The back is dull yellowish brown and the underparts are hoary gray. Females have four pairs of mammae.

The incisors are very prodont and the condylobasal length exceeds the occipitonasal length (Ellerman 1961b). The auditory bullae are enlarged, averaging 18 to 22% of the occipitonasal length. The palatal foramina are extremely short, and the zygomatic arches flair widely from the sides of the skull.

These rodents are fossorial in habit and burrow extensively. Heaps of dirt, like mole hills, are thrown out in front of the burrows. Mole rats feed on grasses, roots and grain (Blanford 1891). Little is known about the reproductive biology except that pregnant females have been taken in March and April from Iran (Walker et al. 1964b).

Gray (1846) reported that a single damaged specimen was collected by Hodgson from the central hilly region of Nepal. One would question the validity of this record since the present distribution of N. indica does not extend into the hilly regions. Weigel (1969) collected two specimens from the Rapti Valley. On 18 February, 1968, three females were taken by the NEP from Tamispur, Nawal Parasi District. In the Rapti Dun burrows of these rodents were seen close to cultivated fields. Specimens were caught by placing a #4 rat trap in the burrow entrances.

ECTOPARASITES

Ixodoidea:	Rhipicephalus sp.
Parasitoidea:	Hypoaspis lubrica
	Laelaps sp.
Anoplura:	Polyplax asiatica

Tatera indica indica (Hardwicke, 1807)

Indian Gerbil; Antelope Rat

1807. Dipus indicus Hardwicke. Trans. Linn. Soc. London 8: 279.

Type locality: Between Benares and Hardwar, United Provinces, northern India.

1838. Gerbillus otarius Cuvier. Trans. Zool. Soc. London 2: 144, pl. 26, figs. 14-18.

Type locality: Peninsular India.

1867. Gerbillus indicus Jerdon. The Mamm. of India. p. 184.

1906. Tatera persica Wroughton. Ann. Mag. Nat. Hist. 17: 477, 496.

Type locality: Seistan, Persia.

1906. Tatera bailwardi monticola Wroughton. Ann. Mag. Nat. Hist. 17: 498.

Type locality: Malamir, Persia.

1917. Tatera sherrini Wroughton. J. Bombay Nat. Hist. Soc. 25(1): 43.

Type locality: Jacobabad, Sind, India.

1917. Tatera dunni Wroughton. J. Bombay Nat. Hist. Soc. 25(1): 43.

Type locality: Ambala, Punjab.

Distribution: Nepal Terai, Punjab, Central Provinces of India, Sri Lanka, Sind, Afghanistan, southwest Persia, Syria, Iraq, Saudi Arabia.

Nepal Records: Hinton and Fry (1923, p. 419).

NEP: 3 specimens: Mitchell - 3.

Habitat: Alluvial soils and dry stream beds of the western Terai and Dang Valley. Uncultivated plains from 90 to 1000 m.

Field Notes: Indian gerbils differ from other murids of the area by their elongated hind legs, hairy tail and biserially cuspidate molars. The back varies from sandy brown to nearly reddish; the underparts are white. There is a sharp line of demarcation between the dorsal and ventral parts. The tail is dark brown with a light brown band down

each side, tipped with a pencil of long, dark hairs. The feet are usually white. The number of mammae is eight.

The skull is large and the occipitonasal length is usually more than 40 mm. The nasals are unusually long, over 40% of the occipitonasal length. The auditory bullae are small, usually less than 25% of the occipitonasal length. The molars in adults are relatively complex with a series of transverse plates or oval patterns formed on the crowns.

These nocturnal rats are commonly found in large colonies. They inhabit open sandy plains along the edges of cultivation where they burrow in sandy soil to a depth of one meter or more. Tatera usually walk on all fours, but when alarmed, they flee in running bounds, leaping 2 to 3 meters in a single bound.

The diet consists of bulbs, roots, seeds and green plant material. Both Prater (1965) and Walker et al. (1964b) contended that these rodents have carnivorous tendencies, feeding on insects, grubs, eggs and nestlings of ground birds and sometimes immatures of their own kind.

Breeding takes place throughout the year and three to four litters are produced annually. There are usually four to eight young per litter, but females may have up to 12. A female collected on 9 April and another on 23 April were lactating. A female taken on 25 April bore six uterine scars.

Two Indian gerbils were collected from the western

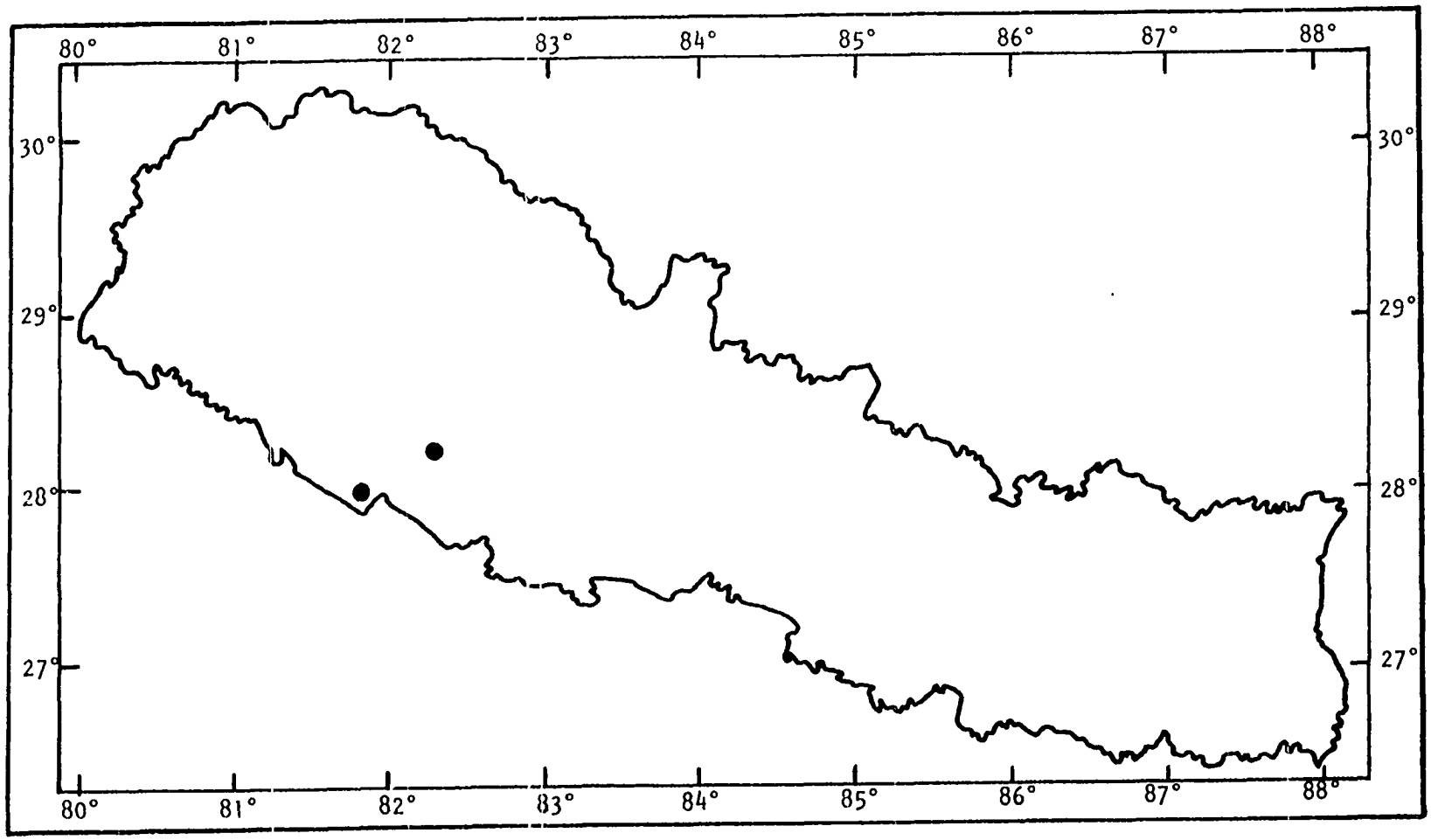


Fig. 50. Collection sites for Tatera indica

Terai and another from the Dang Dun. All three were taken from dry stream beds away from cultivation, and extensive burrow systems were lacking at the collection sites.

ECTOPARASITES

Siphonaptera:	Xenopsylla astia
Ixodoidea:	Rhipicephalus ramachandrai
Parasitoidea:	Androlaelaps marshalli Haemolaelaps sp. Hypoaspis miles Laelaps buxtoni
Mallophaga:	Myrsidea sp.
Anoplura:	Polyplax spinulosa

Alticola stoliczkanus (Blanford, 1875)

Stoliczka's High Mountain Vole

1875. Arvicola stoliczkanus Blanford. J. Asiat. Soc. Bengal 44(2): 107.

Type locality: Kuenlun Mountains, northern Ladak.

1891. Microtus stoliczkanus Blanford. The Fauna Brit. India, Mamm. p. 430.

1896. Microtus (Alticola) stoliczkanus Miller. Proc. Acad. Nat. Sci. Philadelphia 1899, p. 292.

Type locality: Ladak, near headwaters of the Yarkand River.

1926. Alticola stoliczkanus (Blanford), in Hinton. Monograph of voles and lemmings. p. 320.

Distribution: Northern Ladak, Tibet, Mustang District of Nepal.

NEP: 23 specimens: Mitchell - 23.

Habitat: The Tibetan steppe biotope of the Mustang District.

Field Notes: This vole is a bright ferruginous brown above and white below with the two colors sharply delineated. The fur is soft and woolly, the ears are small and completely concealed and the feet and tail are white. The tail is short, about 25% of the length of the head and body, but it is longer than the hind foot. The number of mammae is eight.

The palate terminates in a square-edged, thin shelf of bone that lacks an upward-sloping bony bridge connecting its median point with the inner borders of the two lateral pits. This character separates Alticola from the genus Pitymys. The skull of Alticola is rather long with a condylobasal length approximating 29 mm. The upper third molar is reduced and it has an anterior loop, preceded by two clear triangles, and a short, straight posterior loop (Fig. 52 A and B).

These voles inhabit rocky, mountainous regions of the Mustang District between 4000 to 5000 m. They are somewhat colonial and feed on seeds, grain and plant material. Three specimens had their cheek pouches filled with seeds: 2.1, 1.4 and 1.8 gms, respectively. Seeds from eight different plants were identified: Anemone sp., Potentilla sp., Sedum sp., wheat and three different legumes.

Females apparently have two to three litters a year,

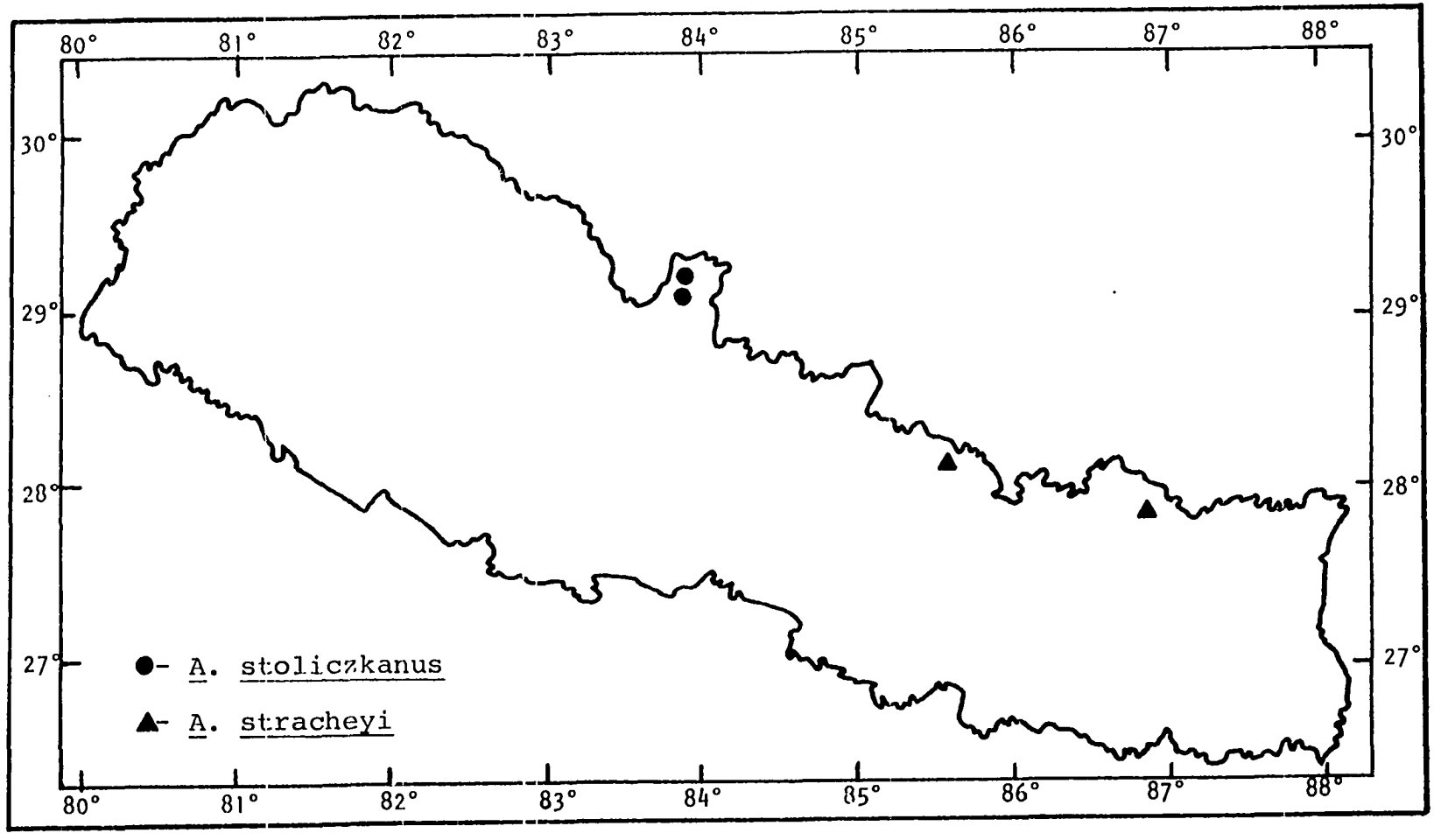


Fig. 51. Collection sites for Alticola sp.

with five to eight young in each litter.

Previously, A. stoliczkanus was known to occur only in northern Kashmir and western Tibet.

ECTOPARASITES

Siphonaptera: Amphalius clarus
Amphipsylla quadratedigita
Callopsylla n. sp.
Ctenophyllus n. sp.
Frontopsylla hollandi
Genoneopsylla longisetosa
Macrostylophora lupata
Neopsylla angustimanubra
Paradoxopsyllus acanthus
P. magnificus
P. spinosus
Paraneopsylla ioffi nepali
Rhadinopsylla n. sp.
Stenoponia n. sp.
New Genus

Ixodoidea: Anomalohimalaya lama

Alticola stracheyi (Thomas, 1880)

The Kumaon Vole

1851. Cricetus songarus Horsfield. Catalogue East Ind. Mus. p. 145.

1880. Arvicola stracheyi Thomas. Ann. Mag. Nat. Hist. 6: 332.

Type locality: Ladak (originally Kumaon).

1891. Arvicola (Alticola) stracheyi Sclater. Cat. Mamm. Indian Mus. pt. 2, p. 90.

1891. Microtus stracheyi Blanford. The Fauna Brit. India, Mamm. p. 431.

1899. Microtus cricetulus Miller. Proc. Acad. Nat. Sci. Philadelphia. p. 294.

Type locality: Tso-Kyun, Ladak.

1920. Microtus (Alticola) stracheyi Wroughton. J. Bombay Nat. Hist. Soc. 27: 60.

Type locality: Ladak.

1955. Alticola bhatnagari Biswas and Khajuria. Proc. Zool. Soc. Calcutta 8(1): 29. (new syn.)

Type locality: Mingbo, Langmoche Valley, Solukhumbu District, Nepal.

1966. Alticola stoliczkanus stracheyi Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed., p. 673.

Distribution: Kashmir, Kumaon, northern Nepal, Western Tibet.

Nepal Records: Biswas and Khajuria (1957, p. 246).

NEP: 5 specimens: Mitchell - 5.

Habitat: Alpine meadows of the inner Himalayas from 3900 to 4500 m.

Taxonomic Notes: In 1880, Thomas described Alticola stracheyi as a new species, but Ellerman (1947b), reclassified it as a subspecies of A. stoliczkanus. Ellerman and Morrison-Scott (1966) also treated A. stracheyi as a subspecies of A. stoliczkanus.

In 1955, Biswas and Khajuria described a new species of vole, Alticola bhatnagari, from eastern Nepal. They stated, "Alticola bhatnagari is separable from all other species of

the genus by the following combination of characters: Tail is subequal to the hind foot and is bicolored. Skull is not flattened. Third upper molar has only two salient angles on the inner side and its posterior loop is long and narrow. Further, the skull is similar to that of Alticola stracheyi, but Alticola bhatnagari is distinguished by its bicolored tail and smaller size."

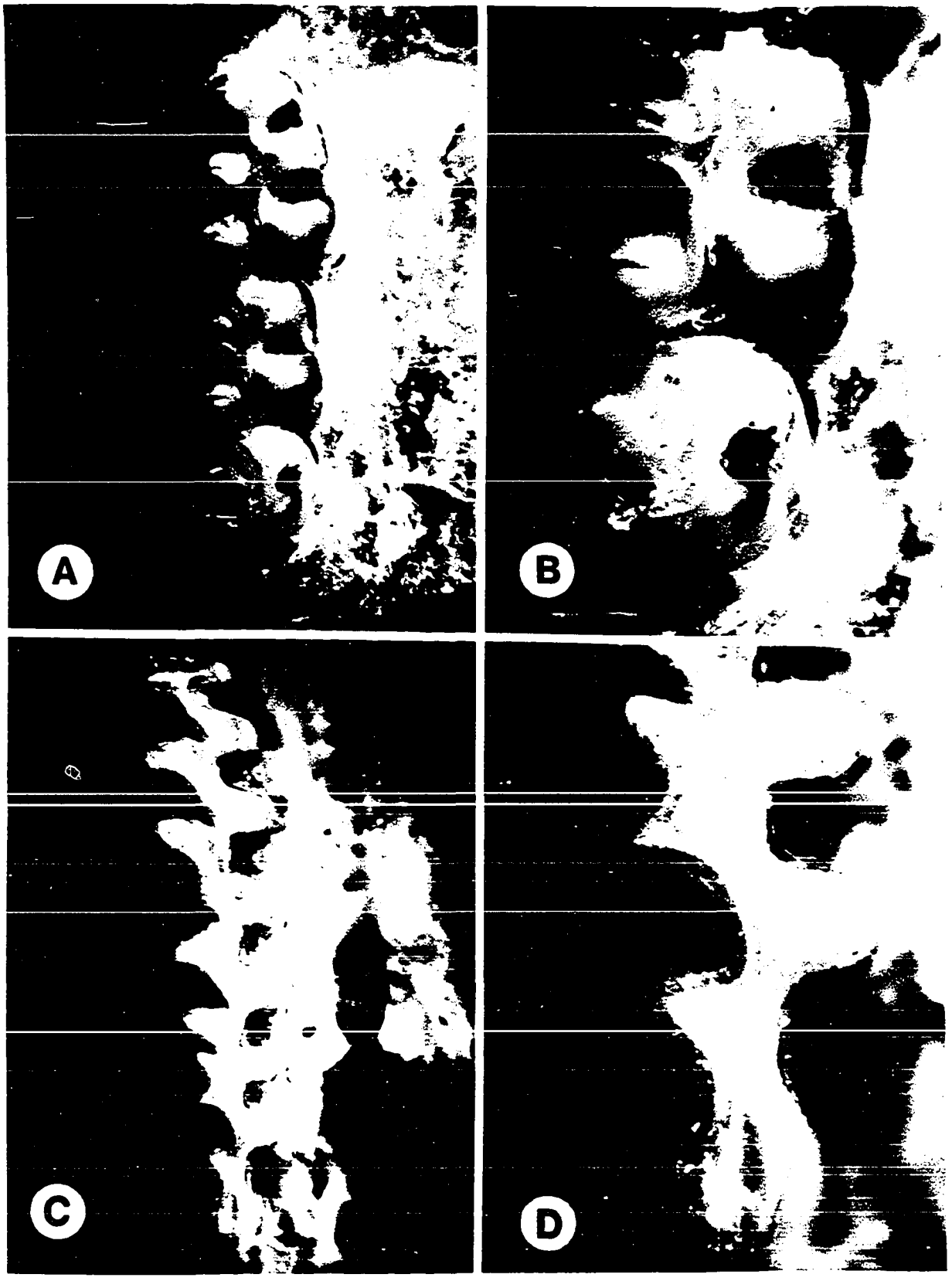
Atticola stracheyi differs from A. stoliczkanus by the following: (1) In A. stoliczkanus the tail is longer than the hind foot (27.8 mm vs. 18.1 mm), while in A. stracheyi the tail and hind foot are nearly equal in length (20.5 mm vs. 18.8 mm). (2) In A. stoliczkanus the posterior loop of M_3 is less than half the length of the tooth, while in A. stracheyi the posterior loop of M_3 is long and narrow, more than half the tooth length (Fig. 52). (3) A. stoliczkanus differs in overall size and color from A. stracheyi and (4) they both differ in habitat preference.

Specimens of A. stracheyi collected by the NEP were compared with the holotype of A. bhatnagari and it was concluded that these two species were the same; therefore I consider A. bhatnagari a synonym of A. stracheyi.

Field Notes: In this vole, the fur is very soft, fine and dense. The upper parts are pale yellowish brown, the venter whitish gray. The feet and tail are pure white or cream colored. The ears are rather short and do not extend beyond the fur. The tail is about as long as the hind foot

Fig. 52. Upper molars of Alticola sp.

A. Upper tooth row of Alticola stoliczkanus (20X)
B. Molars two and three (M_2 and M_3) of A. stoliczkanus (120X)
C. Upper tooth row of A. stracheyi (15X)
D. Molar three (M_3) of A. stracheyi (50X)


A
B
C
D

and is densely clothed with long hair. Four pairs of mammae are present.

Cranial features include a small braincase, a condylobasal length of 24 to 27 mm and check teeth characterized by the peculiar form of M_3 (Fig. 52 C and D). In M_3 there are three outer and only two inner salient angles. The third triangle forms the third outer angle and opens behind into the posterior loop. The posterior loop is long and extremely narrow.

These voles inhabit the high alpine meadows of the Langtang Valley and the northern Himalayas from 4000 to 4500 m. The diet consists of alpine flowers, grasses and seeds. Little is known about the breeding biology; it is probably similar to that of A. stoliczkanus.

ECTOPARASITES

Siphonaptera: Amphipsylla n. sp.
Stenischia n. sp.

Ixodoidea: Ixodes lindbergi (="ovatus")

Pitymys leucurus leucurus (Blyth, 1863)

Blyth's Vole

1863. Phaiomys leucurus Blyth. J. Asiat. Soc. Bengal 32: 89.

Type locality: Near Lake Chomoriri, Ladak.

1875. Arvicola blythi Blanford. J. Asiat. Soc. Bengal 44 (2): 107.

Type locality: Panking Lakes, western Tibet.

1891. Microtus blythi Blanford. The Fauna Brit. India, Mamm. p. 432.

1920. Microtus (Phaiomys) blythi Wroughton. J. Bombay Nat. Hist. Soc. 28(1): 60.

Type locality: Western Ladak.

1947. Pitymys leucurus leucurus (Blyth), in Ellerman. J. Mammal. 28(3): 277.

Distribution: Kashmir, Tibet, Mustang District of Nepal.

NEP: 22 specimens: Mitchell - 22.

Habitat: Stream beds and river banks of the alpine desert region of Mustang, 3600 to 4000 m.

Field Notes: The pelage of this species is moderately thick and the ear reduced (7.9 to 9.0 mm). The tail is short, less than 30% of the head and body length, and is well-clothed with dense hair. The back is pallid, yellowish brown with the basal fur dark charcoal. The belly is yellowish or grayish. The tail and feet are whitish. Four pairs of mammae are present, two abdominal and two inguinal.

The skull is massive and angular with the frontal ridges fused to form a medial interorbital ridge. The posterior palate terminates as a simple transverse shelf (Hinton 1926), a character employed to separate Pitymys and Microtus from the other genera of Indian Microtinae. The auditory bullae are usually more than 6.5 mm long. The range for eight Nepalese specimens was 6.6 to 7.4 mm. Molar three

is strongly reduced with two folds on each side and with a short heel. The occipitonasal length is 24 to 27 mm and the palatal length is usually over 60% of the occipitonasal length.

Blyth's voles are colonial, digging burrows along the edges of wheat fields and in clumps of grass along streams. The diet consists of grass seeds, flowers, wheat and fresh vegetation.

The breeding season runs from March through August and the litter size is two to five with two to three litters produced annually. The gestation period is about 21 to 23 days. On 28 May, 1970, a female taken had two embryos that averaged 19.9 mm in length. Blanford (1891) once found a litter of six in Tibet.

In March and May, 1970, these voles were trapped in and around the village of Mustang, Mustang District. This is the first collection of P. leucurus from Nepal.

ECTOPARASITES

Siphonaptera:	Amphipsylla quadratedigita
	Callopsylla n. sp.
	Neopsylla angustimanubra
	Paradoxopsyllus acanthus
	P. magnificus
	P. spinosus
	Paraneopsylla ioffi nepali New Genus
Ixodoidea:	Anomalohimalaya lama
Anoplura:	Hoplopleura acanthopus

Pitymys sikimensis (Hodgson, 1849)

Sikkim Vole

1849. *Neodon sikimensis* (Hodgson), *in* Horsfield. Ann. Mag. Nat. Hist. 3: 203.

Type locality: Sikkim.

1863. *Arvicola thricolis* Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 10. (*nom. nud.*)

Type locality: Darjeeling.

1891. *Microtis sikimensis* Blanford. The Fauna Brit. India, Mamm. p. 433.

1947. *Pitymys sikimensis* (Hodgson) *in* Ellerman. J. Mammal. 28(3): 278.

1969. *Pitymys sikimensis irene* (Thomas), *in* Weigel. Khumbu Himal. 3(2): 302.

Type locality: Western Szechuan.

Distribution: Sikkim, Darjeeling, Nepal.

Nepal Records: Fry (1925, p. 530), Biswas and Khajuria (1957, p. 247), Weigel (1969, p. 150), Abe (1971, p. 421).

NEP: 360 specimens: Mitchell - 292; Maser - 37; AVWE - 31.

Habitat: A number of biotopes in the midlands and inner Himalayas, from treeline to alpine meadows; 2700 to 4600 m.

Taxonomic Notes: Members of the subgenus *Neodon* are closely related to the subgenus *Pitymys*. The supraorbital ridges are fused in *Neodon* while in *Pitymys* they are separated. The first lower molar has two pairs of confluent triangles

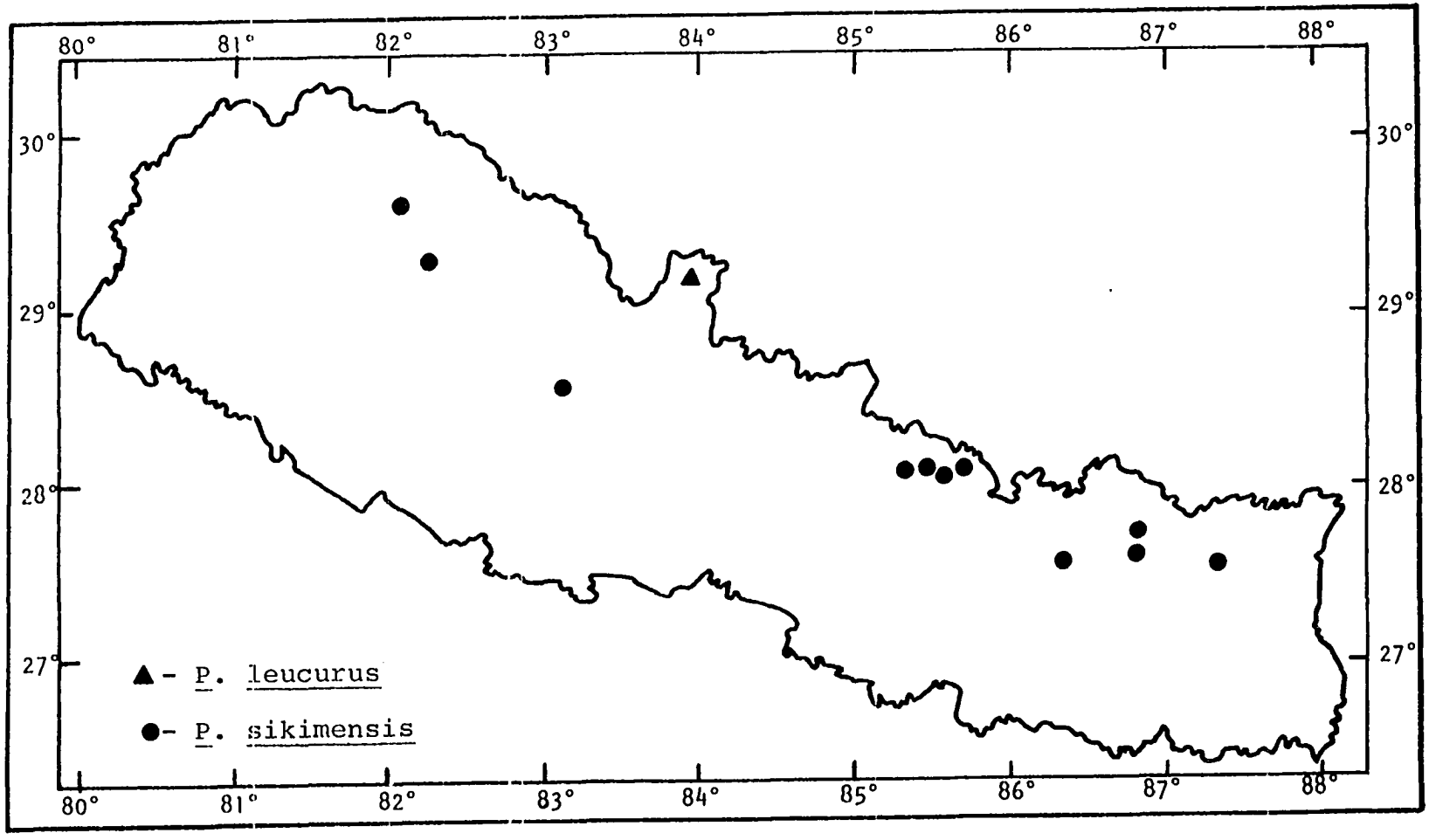


Fig. 53. Collection sites for Pitymys sp.

in front of three closed ones; the upper tooth row is usually more than 25% of the occipitonasal length (Ellerman 1947b). The auditory bullae are relatively small, 5.3 to 6.1 mm for nine specimens.

In external appearance, the Neodon group is more like Microtus; the eyes, ears and tail are not reduced. The Pitymys group is modified for a fossorial-type of existence through the reduction in size of eyes, ears and tail (Hinton 1926).

Weigel (1969) treated P. irene as a subspecies of P. sikimensis. Allen (1938) and Ellerman (1961a) recognized irene as a valid species because of the following: (1) the first lower molar has only one pair of confluent triangles in front of three closed ones; (2) the upper tooth row is less than 25% of the occipitonasal length and (3) the bullae are relatively large, 6.4 mm or more.

Field Notes: The pelage is soft and dense, the ears moderately large (11.2 to 15.2 mm) and the tail somewhat long (28.6 to 30.1% of the head and body length). Dorsally, the fur is deep, dark brown, ventrally pale brown or grayish. The tail is bicolored. The mammary formula is two pairs pectoral and two inguinal.

The skull is angular and well-ridged. The occipitonasal length is 25 to 28 mm. The auditory bullae are small, averaging less than 25% of the occipitonasal length. The palate is long, usually over 60% of the occipitonasal length.

The first lower molar has two pairs of confluent triangles in front of three closed ones. The upper tooth row is often more than 25% of the occipitonasal length.

Sikkim voles are colonial, living in large complexes. As many as 20 to 30 burrows are found in a single complex. When several burrows, which are 18 to 30 cm deep and 2 to 4 m long, were excavated, nest chambers were found at the end of the main gallery. The nest is a ball of finely shredded plant and fibrous material.

These voles were heard to produce a number of vocalizations. When alarmed, they utter a high-pitched squeak. On several occasions, their high-pitched trill, like that of a bird, was heard.

Sikkim voles were collected from a number of different habitats. In eastern Nepal, they were trapped from alpine regions of the inner Himalayas. Most specimens were taken from large boulder piles and stone walls surrounding buckwheat and potato fields. In central Nepal, they were collected from high alpine meadows. In western Nepal, they were caught from clumps of ephedra (Ephedra sp.) and stunted junipers (Juniperus sp.).

They feed chiefly on seeds, green plants, lichens, flowers and roots and are active throughout the year. They breed two to three times a year with peak breeding activity during March-April and August-October. The litter size is one to four with three the average. Of the 101 females examined,

22 were carrying embryos (Table 14). During March and April, 105 individuals were examined; 87.5% were immatures and 20.9% of the females were either pregnant or had already given birth to young. Of 140 voles checked between August and October, 9.28% were immatures and 24% of the adults showed signs of having bred. Over 55% of the females were pregnant, bore uterine scars, or were lactating. Males with enlarged testes were collected from March through June and from September through October. The reproductive season extends into November. Two females bearing embryos, two lactating and two with uterine scars, were collected during this time.

The previous reported western limits of P. sikimensis was the Solukhumbu region (86° 44'E) of eastern Nepal. Our collections from Rara Lake, Mugu District, extend its known range approximately 425 km west to 82° 05'E longitude.

ECTOPARASITES

Siphonaptera:
Amphipsylla n. sp.
Citellophilus mygala
C. atallahi
Ctenophyllus n. sp.
Neopsylla mantissa
N. marleaneae
N. pagea
N. secura
Nosopsyllus simla
Palaeopsylla helenae
P. tauberi
Paradoxopsyllus acanthus

P. hollandi
P. n. sp.
Rhadinopsylla n. sp.
Stenischia n. sp.
Stenoponia n. sp.
Evansipsylla thysanota
Malaraeus n. sp.

Ixodoidea:
Boophilus microplus
Haemaphysalis aponommoides
H. warburtoni
Ixodes acutitarsus
I. lindbergi (="ovatus")
I. sp. 1
I. sp. A
I. sp. B

Parasitoidea:
Androlaelaps sp.
A. fahrenholzi
A. pavlovskii
Eulaelaps stabularis
Haemogamasus horridus
H. japonicus
H. nidiformis
H. oliviformis
H. suncus
H. fahrenholzi
Histionyssus sp.
H. latiscutatus
H. suncus
Hypoaspis sardoa
Laelaps sp.
L. algericus
L. traubi
L. turkestanica

Macrocheles sp.
Ascidae
Macrochelidae
Pachylaelapidae
Pyemotidae

Uropodoidea:
Uropodina sp.

Anoplura:
Hoplopleura acanthopus
H. capitosa
Polyplax sp.

Table 14. Female Pitymys sikimensis bearing embryos

Host Number	No. of embryos	Length (in mm)	Date
1161	3	15.7	3 September 1968
1223	3	27.5	10 September 1968
1235	3	-	11 September 1968
1357	2	9.0	14 October 1968
1905	1	10.4	22 November 1968
1953	2	21.8	24 November 1968
2245	3	11.7	15 March 1969
2310	3	4.1	23 March 1969
2322	2	11.8	25 March 1969
2327	1	9.8	25 March 1969
2343	2	23.4	26 March 1969
2379	1	10.5	30 March 1969
2942	3	11.2	9 August 1969
2964	3	13.1	10 August 1969
2983	4	5.3	11 August 1969
2998	2	8.1	12 August 1969
3001	4	13.0	12 August 1969
3032	2	2.8	14 August 1969
3171	1	7.4	3 October 1969
3201	2	5.8	4 October 1969
3221	2	5.4	5 October 1969
3222	2	4.8	5 October 1969

ORDER CARNIVORA

Canis lupus chanco Gray, 1863

Asian Wolf

1847. *Lupus laniger* Hodgson. J. Nat. Hist. Calcutta 7: 474.

Type locality: Tibet.

1863. *Canis chanco* Gray. Proc. Zool. Soc. London. p. 94.

Type locality: Chinese Tartary (Mongolia).

1874. *Canis niger* Sclater. Proc. Zool. Soc. London. p. 655. pl. 78.

Type locality: Hanle, Kashmir.

1890. *Canis lupus* var. *chanco* Mivart. Monograph of the Canidae. p. 8, pl. 3.

Type locality: Mongolia.

1907. *Lupus filchneri* Matschie. Filchner's Expd. to China, Wiss. Ergebn. 10(1): 153.

Type locality: Siningfu, Kansu, China.

1907. *Lupus karanorensis* Matschie. Loc. cit. 10(1): 159.

Type locality: Karanor, Gobi.

1907. *Lupus tschiliensis* Matschie. Loc. cit 10(1): 160.

Type locality: Coast of Chihli, China.

1929. *Canis lupus laniger* Allen. Amer. Mus. Nov. 360: 4.

Type locality: Mongolia.

1942. *Canis lupus chanco* Gray, in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 86.

Distribution: Pamirs, Kashmir, Tibet, Mongolia,

northern China, northern Nepal.

Nepal Records: Biswas and Khajuria (1957, p. 233).

Habitat: Alpine valleys of the inner Himalayas from 3330 to 5450 m, possibly the Tibetan steppe biotope of the Mustang District.

Taxonomic Notes: The following names were applied to Chinese wolves: Lupus filchneri, L. karanorensis and L. tschiliensis. Because the characters given to distinguish these species were not distinctive, Allen (1938) regarded these names as synonyms of C. l. chanco.

Field Notes: The Asian wolf has a large, elongate head, a heavy body, slender limbs, and a moderately long, bushy tail. The upper parts and outside of the limbs are rufous or yellowish gray mixed with black, with the lower parts dirty white. The underfur on the back is pale slate or light brown, intermixed with coarse whitish hairs. The muzzle is pale chestnut, or ochreous, slightly mixed with gray. The black tipped tail is pale ochreous buff mixed with longer black hairs. There are generally 10 mammae. The length of the head and body is 1000 to 1300 mm, the length of the tail 300 to 500 mm and the weight 30 to 65 kg.

Skull features are an elongate muzzle, short postorbital processes and inflated auditory bullae. The dental formula is: i. 3/3; c. 1/1; pm. 4/4; m. 2/3 = 42 (Allen 1938).

Asian wolves are found in both open country and

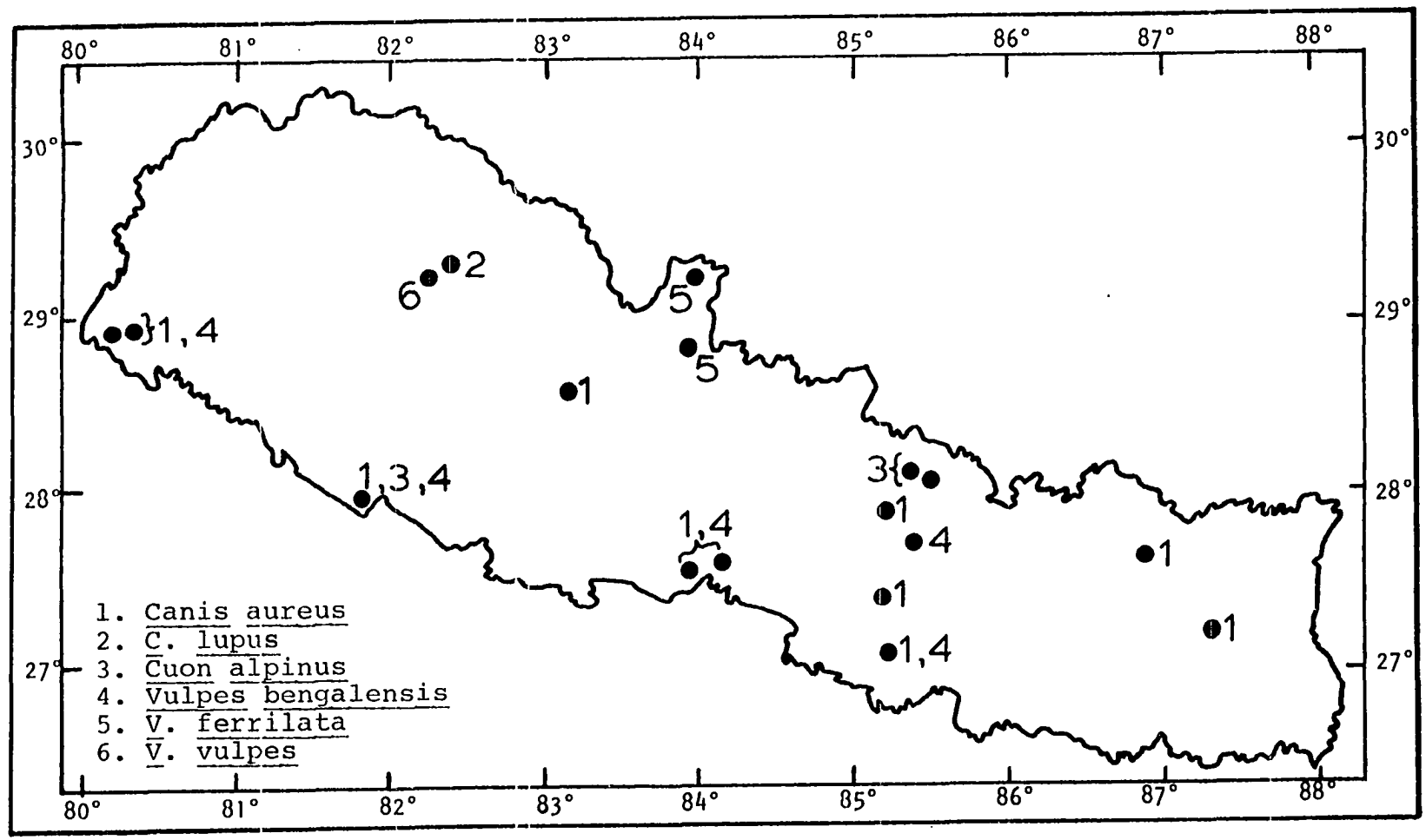


Fig. 54. Collection sites and sightings for family Canidae

forested areas of the Himalayas. They are solitary, but sometimes occur in pairs. They feed upon any mammal or bird that they can kill and they readily eat carrion. They also feed on vegetable matter.

Blanford (1891) found the mating season to be from December to April with a gestation period of 60 to 70 days. Young are born in the spring and early summer with a litter size of four to nine. Biswas and Khajuria (1957) collected wolf pups in May from the eastern Himalayas.

Reports of wolves from Nepal are quite rare. Thomas and Hinton (1922) sighted one at 5700 m on the northern slope of Mt. Everest and Biswas and Khajuria (1957) collected five pups from the Solukhumbu District. In May, 1966, I sighted a wolf near Jumla, Jumla District, in a Pinus-Picea forest (3300 m).

Canis aureus indicus Hodgson, 1833

Asiatic Jackal

1833. Canis aureus indicus Hodgson. Asiat. Res. 18(2): 237.

Type locality: Nepal.

1841. Sacalius indicus Hodgson. J. Asiat. Soc. Bengal 10: 918. (nom. nud.)

Type locality: Nepal.

1841. Oxygoris indicus Hodgson. J. Asiat. Soc. Bengal 10: 918. (nom. nud.)

Type locality: Nepal.

1916. Canis indicus indicus Wroughton. J. Bombay Nat. Hist. Soc. 24(3): 650.

Type locality: Nepal.

Distribution: Nepal, Sikkim, Bhutan, Assam, Burma.

Nepal Records: Hodgson (1833c, p. 237; 1841e, p. 918), Gray (1846, p. 11), Wroughton (1916, p. 650), Hinton and Fry (1923, p. 413), Fry (1925, p. 527), Chesemore (1970, p. 164).

NEP: 20 specimens: Mitchell - 14; Maser - 1; AVWE - 5.

Habitat: The scrub jungles of the Terai and duns and the deciduous forests of the midlands, from 90 to 3000 m.

Field Notes: The jackal is smaller than the wolf and its coat is more shaggy. The head is also smaller and lacks the broad, elevated forehead. The color of the upper parts is pale rufous mixed with black. The muzzle, ears and outside of the limbs are rufous. The lower parts are paler, sometimes nearly white. The tail is reddish brown mixed with black hairs. Females have 10 mammae.

Jackals were collected from the dry, open plains of the Terai (90 m) to the subalpine valley of Dhorpatan, Dolpa District (3000 m). They are common around towns, villages and cultivated areas. Most active at dusk and night, jackals hunt alone or in pairs, but sometimes they form packs. Mostly scavengers, they have been known to hunt and kill small animals. Jackals seek shelter in burrows, dense grass and scrub brush. Individuals are quite bold and have on occasion

approached within 10 m of camp.

The breeding season is continuous and pups are born throughout the year. Blanford (1891) reported the average number of young born each litter as four, while Walker et al. (1964b) gave the litter size as two to seven. Lactating females were collected in March, April and May.

Jackals responded readily to a predator call and were frequently lured within 10 to 25 m of a blind. A method employed to collect them was night hunting by jeep equipped with a high intensity spot light. Individuals were sighted by use of the light and were then shot.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis
	C. f. orientis
	Pulex irritans
Ixodoidea:	Amblyomma sp.
	Haemaphysalis bispinosa
	H. indica
	Hyalomma sp.
	Ixodes lindbergi (="ovatus")
	Rhipicephalus haemaphysaloides
	R. sanguineus
Anoplura:	Linognathus setosus

Vulpes vulpes montana (Pearson, 1836)

Red Fox

1836. Canis vulpes montana Pearson. J. Asiat. Soc. Bengal 5: 313.

Type locality: Himalayas.

1837. Canis himalaicus Ogilby. Proc. Zool. Soc. London. 1836, p. 103.

Type locality: Mussooree, Kumaon, India.

1837. Vulpes nipalensis Gray. Charlesworth's Mag. Nat. Hist. 1: 578.

Type locality: Nepal.

1843. Vulpes flavescens Gray. Ann. Mag. Nat. Hist. 11: 118.

Type locality: Lhasa, Tibet.

1887. Vulpes alopex Blanford. Proc. Zool. Soc. London. p. 153.

Type locality: Himalayas.

1890. Canis vulpes var. montanus Mivart. A Monograph of the Canidae. p. 96 (plate).

1906. Vulpes waddelli Bonhote. Abstr. Proc. Zool. Soc. London. 14; Proc. Zool. Soc. London, p. 303.

Type locality: Kambajong, Tibet.

1907. Vulpes ladacensis Matschie. Wiss. Ergebn. Filchners Expd. China 10(1): 167.

Type locality: Ladak.

1936. Vulpes vulpes montana (Pearson), in Pocock. J. Bombay Nat. Hist. Soc. 39(1): 38.

Distribution: Afghanistan, Kashmir, northern India, Nepal, Tibet.

Nepal Records: Gray (1846, p. 11), Hinton and Fry (1923, p. 413), Biswas and Khajuria (1957, p. 234).

Habitat: Rhododendron and coniferous forests of the western midlands from 1800 to 3000 m; the alpine regions of the inner Himalayas from 2400 to 4500 m.

Field Notes: The red fox is small with a long, bushy tail. The color of the head, back and sides is fulvous. The cheeks, upper lip, belly, inner side of the limbs, and tip of the tail are white. The backs of the ears are black, contrasting strongly with the red color of the head and nape. The black backs of the ears and the white tip of the tail distinguish this fox from other Indian foxes. Four pairs of mammae are present. The head and body length is 400 to 600 mm, the tail length 400 to 500 mm and the weight 4 to 6 kg.

The chief characters of the skull are the long, slender muzzle and the low, flattened postorbital processes. The upper canines are very long and slender.

Red foxes generally live and breed in burrows, but sometimes in holes among rocks. They hunt alone and, less frequently, in pairs. Like other foxes, they feed on birds, small mammals, insects and vegetable matter. Pups are born in March and April and the litter size is usually four to six. The gestation period is between 60 to 64 days (Mivart 1890).

Vulpes bengalensis (Shaw, 1800)

Bengal Fox

1800. Canis bengalensis Shaw. Gen. Zool. 1(2): 330.
Type locality: Bengal.

1831. Canis kokree Sykes. Proc. Zool. Soc. London. p. 101.

Type locality: Deccan, India.

1833. Canis (Vulpes) indicus Hodgson. Asiat. Res. 18(2): 237.

Type locality: India.

1834. Canis (Vulpes) bengalensis Gray, in Hardwicke. Illus. Ind. Zool. 2: pl. 3.

Type locality: India.

1834. Canis (Vulpes) rufescens Gray, in Hardwicke. Illus. Ind. Zool. 2: pl. 3.

Type locality: India.

1837. Vulpes chrysurus Gray. Charlesworth's Mag. Nat. Hist. 1: 577.

Type locality: Nepal.

1837. Vulpes hodgsonii Gray. Charlesworth's Mag. Nat. Hist. 1: 578.

Type locality: Nepal.

1838. Vulpes xanthura Gray. Proc. Zool. Soc. London. 1837: 68.

Type locality: Nepal.

1846. Vulpes bengalensis Gray. Cat. Hodgson's Coll. B. M. p. 11.

Type locality: Nepal Terai.

Distribution: The whole of India, Nepal to Assam.

Nepal Records: Gray (1846, p. 11), Hinton and Fry (1923, p. 413), Chesemore (1970, p. 165).

NEP: 7 specimens: Mitchell - 7.

Habitat: Alluvial plains of the Terai and duns around villages and agricultural areas, scrub jungle of the larger hill valleys; 100 to 1500 m.

Field Notes: Vulpes bengalensis is distinguished from Vulpes vulpes by the black tipped tail, the ears the same color as the nape, the presence of three pairs of mammae and the shorter, more grizzled pelage.

The short, smooth coat is brownish buff or ochreous in color with the contour hairs banded, giving the fur a speckled appearance. The tail is more than 50% the head and body length. The ear length is usually less than 80 mm (average of 76.7 mm for five specimens), but is always more than half the hind-foot length.

Bengal foxes usually inhabit the open plains of the Terai, but they have been sighted in the larger valleys (Pokhara, Dang, Kathmandu) of the Siwalik and Mahabharat Ranges. They live in burrows dug in open ground or in scrub jungle. Each burrow has several openings and is usually located on higher ground along a bank or prominent ridge. Generally nocturnal, they are also active throughout the day. During the heat of the day, they usually take refuge in their burrows or in patches of scrub brush.

Several authors (Blanford 1891; Jerdon 1867; Prater 1965) have reported that the diet consists of small mammals, reptiles, birds, insects and fruit. Bengal foxes were seen hunting along rice paddies, ditch banks and hedge rows and feeding on small rodents and insects.

According to Blanford (1891), mating takes place from

November through January and the young, usually four, are born from February to April. A female shot on 30 December, 1969, at Madhuban was carrying three embryos. On 22 September, 1969, a female and three pups three-quarters grown were collected near Gokarna Reserve, Kathmandu. This was the highest elevation (1350 m) at which these foxes were sighted.

Often, these foxes responded to a predator call. At Bahwanipur, Banke District, seven responded simultaneously to a single call. However, they are more cautious in approaching the call than jackals or jungle cats. These foxes would circle our blind until they had approached within 25 to 30 m, then they would lie down and wait. Sometimes they would wait at a distance and yap or bay at the blind.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis C. f. orientis Pulex irritans
Ixodoidea:	Haemaphysalis bispinosa
Mallophaga:	Trichodectes canis

Vulpes ferrilata Hodgson, 1842

Tibetan Sand Fox

1842. Vulpes ferrilatus Hodgson. J. Asiat. Soc. Bengal 11: 278.

Type locality: near Lhasa, Tibet.

1863. Cynalopex ferrilatus Blyth. Cat. Mamm. in B. M. p. 41.

Type locality: Tibet.

1941. Vulpes ferrilata Hodgson, in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 140(renaming of ferrilatus).

Distribution: Tibet and Mustang District of Nepal.

NEP: 1 specimen: Mitchell - 1.

Habitat: Alpine desert biotope of the Mustang District from 3000 to 4000 m.

Field Notes: The Tibetan sand fox has a dense, woolly coat and a bushy tail. The ears are short and the fur is long, especially on the legs. The back and sides are a pale rusty yellow and the lower parts are rufous white. The body, chest, sides of neck and most of the tail are nearly pure gray mixed with black and white. The tip of the tail is white. Three pairs of mammae are present. The tail (400 to 475 mm) is more than half the head and body length (575 to 700 mm). Males may weigh up to 7 kg.

In the skull, the auditory bullae are inflated, the rostrum is long and narrow, and the upper canines are elongate.

Sand foxes inhabit the barren slopes and stream beds of the Mustang District. They make their dens in boulder piles or in burrows under large rocks. Pairs were seen hunting along stream beds, boulder heaps and wheat fields. They

prey on rodents (Apodemus sp. and Mus sp.), lagomorphs (Ochotona sp. and Lepus oiostolus), and ground birds. They breed in late February and two to five young are born in April and May.

Sand foxes are common in the northern regions of Mustang District. On 1 March, 1970, a male was caught in a steel trap baited with a dead chicken. Their tracks were abundant in the new fallen snow along stream banks and around wheat fields. In March, at least 10 individuals were sighted, and on a return trip to the Mustang District (May, 1970), only two were seen.

ECTOPARASITES

Siphonaptera: Chaetopsylla homoea homoea
Neopsylla angustimanubra
Pulex irritans

Cuon alpinus primaevus (Hodgson, 1833)

Dhole, Red Dog or Indian Wild Dog

1833. Canis primaevus Hodgson. Asiat. Res. 18(2): 221.

Type locality: Nepal.

1841. Cuon primaevus Hodgson. J. Asiat. Soc. Bengal 10(2): 909.

Type locality: Nepal.

1863. Cuon grayiformis Hodgson, in Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 5.

Type locality: Sikkim.

1936. Cuon javanicus primaevus Pocock. Proc. Zool. Soc. London. p. 45.

1941. Cuon alpinus primaevus (Hodgson), in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 152.

Distribution: Kumaon, Nepal, Darjeeling, Sikkim, Bhutan.

Nepal Records: Hodgson (1833c, p. 221; 1841e, p. 909), Gray (1846, p. 10; 1863b, p. 5), Hinton and Fry (1923, p. 413).

NEP: 1 specimen: Maser - 1.

Habitat: The jungles of the Terai and the rhododendron forests of the midlands, also alpine regions above treeline; from 90 to 5000 m.

Taxonomic Notes: Cuon resembles the genus Canis, but differs in having only two true molars on each side of the lower jaw instead of three. Also the muzzle is shorter and the mammae are more numerous. There are 12 to 14 teats as compared to 10 in Canis (Blanford 1891).

Field Notes: Dholes are the size of a large dog. They have a short muzzle with a slightly elevated forehead. The tail is shorter (300 to 450 mm) than that of other canids. They vary in color regionally. In the Terai, the color is a light tawny red with black on the back and a large amount of gray on the sides of the neck and head. Dholes found at high altitudes are chestnut red above with a black muzzle and a black tipped tail. The underparts are white. The head and body length is 800 to 1000 mm and the weight 15 to

22 kg.

Dholes are gregarious, usually associating in groups of four to eight, with packs ranging up to 30. They are active both day and night, but are mainly diurnal. Their diet consists chiefly of meat. They prey on deer, small mammals and livestock, and they feed also on plant material (Blanford 1891). There are reports of wild dogs attacking and killing tigers, wild boar and gaur.

Young are born at all seasons in India, but in Nepal they are usually born during January and February. The litter size is two to six (Walker et al. 1964b). On 5 February, 1967, Maser collected a new born pup from the central midlands.

During March and April, 1968, several packs of wild dogs were seen at Bahwanipur, Banke District. On 3 March, seven dholes were seen chasing two spotted deer (Axis axis). On 5 September, 1968, a single wild dog killed a domestic sheep at Thare Pati, Sindu District and on 12 October, 1969, a pack of 11 dholes were sighted at 4850 m near Gosainkund Pass. Local herdsmen in the central midlands complained about the loss of livestock to wild dogs.

Selenarctos thibetanus thibetanus (Cuvier, 1823)

Asiatic Black Bear

1823. Ursus thibetanus Cuvier. Ossements Foss. 4: 325.

Type locality: Sylhet, Assam.

1841. Ursus torquatus Wagner, in Schreber. Säuget. suppl. 2: 144 (renaming of thibetanus).

1846. Helarctos tibetanus Gray. Cat. Hodgson's Coll. B. M. p. 15. (nom. nud.)

Type locality: Assam.

1917. Arcticonus thibetanus Pocock. Ann. Mag. Nat. Hist. 8(20): 129. (renaming of Ursus).

1920. Selenarctos thibetanus (Cuvier), in Sowerby. J. Mammal. 1: 218.

1938. Euarctos thibetanus thibetanus (Cuvier), in Allen. Mamm. of China and Mongolia. Vol. 1 (part II), p. 333.

1941. Selenarctos thibetanus thibetanus (Cuvier), in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 205.

1944. Ursus (Selenarctos) thibetanus (Cuvier), in Bobrinsky. Mamm. of U.S.S.R. p. 137.

Distribution: Nepal eastward through Assam, Burma, possibly eastern Tibet.

Nepal Records: Gray (1846, p. 15), Hinton and Fry (1923, p. 417), Biswas and Khajuria (1957, p. 235), Chesemore (1970, p. 165).

Habitat: Steep forested hills of the midlands from 1500 to 3700 m, lower valleys in the winter.

Taxonomic Notes: According to Pocock (1941), Wagner proposed torquatus as a substitute for thibetanus because he felt that the older name was inappropriate since the species was not found in Tibet. Gray's (1846) genus, Helarctos, lacking a description, is a nomen nudum. Pocock (1917a)

separated the Himalayan black bear from other bears (Ursus) as a distinct genus -- Arcticonus. Sowerby (1920) pointed out that Arcticonus was antedated by Selenarctos and that the latter stands as the proper generic name. Bobrinsky et al. (1944) included Asiatic bears in the genus Ursus and gave subgeneric ranking to Selenarctos.

Field Notes: The Asiatic black bear is medium-sized with smooth fur which is moderate in length. The hair on the neck and shoulders forms a long ruff. The feet are broad and completely plantigrade, the soles naked (Pocock 1914). Each paw is armed with short, curved claws. The tail is very short and the large ears are covered with long hair. The color is shining black with a prominent white cresentic or V-shaped mark on the forepart of the chest. The chin is white and the nose is reddish brown. Six mammae are present. The head and body length is 1.3 to 1.6 m, the tail length 75 to 100 mm, and the weight 115 to 180 kg. The skull is distinguished from other Asiatic bears by its shortened rostrum (Allen 1938).

Asiatic black bears are omnivorous and according to Blanford (1891), their diet consists of fruits and roots, and mainly acorns in winter. In the central midlands they feed on corn and pumpkins, literally destroying the fields.

These bears are found throughout the central and eastern midlands from 3000 to 4000 m, inhabiting dense

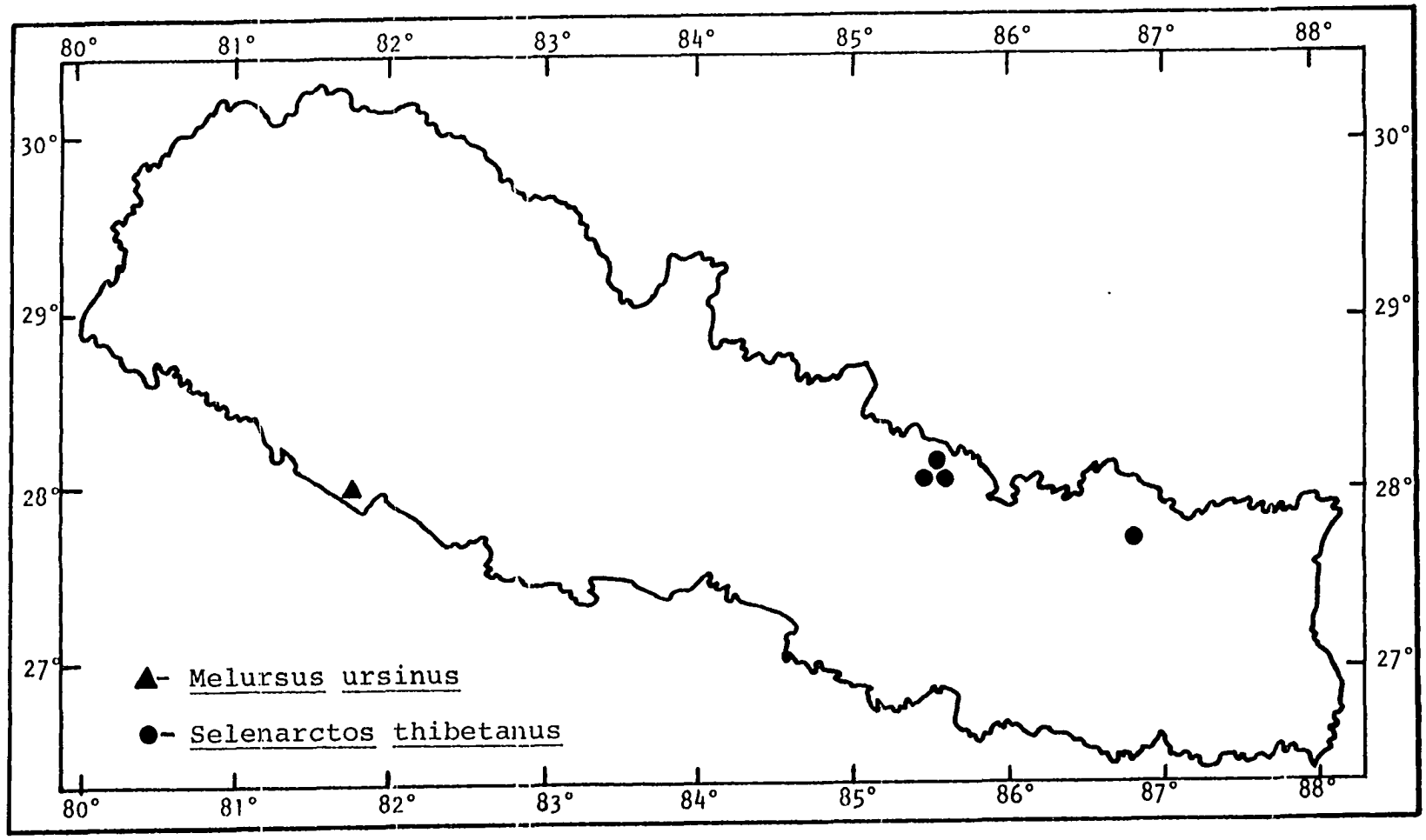


Fig. 55. Sightings for family Ursidae

bamboo thickets. Chesemore (1970) reported sighting this species in the Terai. In June, 1970, a female and her cub were killed by hunters near Thare Pati, Sindu District.

These bears are ill-tempered and there were many reports of them mauling and sometimes killing men.

Melursus ursinus ursinus (Shaw, 1791)

Sloth Bear

1791. Bradypus ursinus Shaw. Nat. Misc. 2 (unpaged) pl. 58-59.

Type locality: Patna, on the Ganges, Bihar, India.

1793. Melursus lybius Meyer. Zool. Entdeckung. p. 156.

Type locality: "Africa Interior".

1817. Ursus labiatus Blainville. Bull. Soc. Philom. p. 74.

1820. Ursus longirostris Tiedemann. Abhandl. Bar. Faulthier. p. 11.

1863. Melursus lybicus Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 8.

1891. Melursus ursinus Blanford. The Fauna Brit. India, Mamm. p. 210.

1941. Melursus ursinus ursinus (Shaw), in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 191.

Distribution: Peninsular India, from Cape Comorin to the base of the Himalayas, Nepal, Bihar.

Nepal Records: Gray (1846, p. 15).

Habitat: Thickets and dense jungle of the Terai and

duns, the deciduous forests of the Siwaliks; from 100 to 1000 m.

Taxonomic Notes: According to Pocock (1941), the holotype of this bear was a living specimen exhibited in London and described by Shaw. Shaw was misled by the loss of its incisors and described it as a new genus of sloths, Bradypus. Meyer perceived that this animal was a sloth bear and named it Melursus lybius, but was mistaken in thinking that it had been collected in Africa (Pocock 1941). Blanford (1891) proposed ursinus as the specific name of Melursus.

Field Notes: The sloth bear has a coarse, shaggy coat and short hind legs. The fur is longest between the shoulders. The muzzle is elongated and the lower lip protrudes. The feet are equipped with long, ivory white claws. The black coloration is often mixed with brown. The chest mark, typically V- or Y-shaped, varies from white to yellow. The length of the head and body is 1.4 to 1.8 m, the length of the tail 100 to 125 mm, the height at the shoulder 600 to 900 mm and the weight 55 to 140 kg (Walker et al. 1964b). The molars and premolars are very small and the latter are separated from each other by a considerable interval.

In the Terai, sloth bears inhabit dense thickets and ravines overgrown with bramble. These thickets are almost impenetrable, and yet they make numerous tunnels through this undergrowth. These animals are generally nocturnal, although

during cool weather they are active throughout the day. They do not hibernate. Their sense of smell is well-developed but their sight and hearing are poor. Their food is fruit, vegetable matter, insects, grubs, honey, eggs and carrion. Prater (1965) reported their main insect food as termites.

Mating takes place at about the onset of monsoons (June). The gestation period is approximately seven months, with young born from October through February, most often in December or January (Pocock 1932). One to two cubs are born in a ground shelter. The cubs remain with the female until they are nearly full-grown, possibly two to three years.

Numerous tracks and spoor of sloth bears were seen near Bahwanipur, Banke District. These animals had been feeding on a dead cow.

Ailurus fulgens fulgens Cuvier, 1825

Red Panda, Lesser Panda

1825. Ailurus fulgens Cuvier, in Geoffroy and Cuvier. Nat. Hist. Mamm. 3(50): 3, pl. 203.

1847. Ailurus ochraceus Hodgson. J. Asiat. Soc. Bengal 16: 1118.

Type locality: "Sub-Himalayas".

1891. Aelurus fulgens Blanford. The Fauna Brit. India, Mamm. p. 190.

Distribution: Nepal, Darjeeling, Sikkim, Tibet.

Nepal Records: Gray (1846, p. 15), Hodgson (1847c,

p. 1118), Hinton and Fry (1923, p. 417), Biswas and Khajuria (1957, p. 235).

NEP: 1 specimen: AVWE - 1; Mitchell (1 skin, 2 sightings).

Habitat: Dense temperate forests and bamboo thickets of the midlands from 1500 to 2800 m.

Field Notes: The lesser panda is a fox-sized carnivore with a rounded head, large, erect ears and a long, bushy tail. The feet are armed with sharp, semiretractile claws which are used for climbing. The upper parts are rusty to deep chestnut in color and the coat is long and soft. The tail is inconspicuously ringed. There are four pairs of mammae. Walker et al. (1964b) listed the measurements as: head and body length 510 to 635 mm, tail length 280 to 485 mm and weight 3 to 5 kg.

The skull is high and compressed and the zygomatic arches are very strong and curve upwards. The auditory bullae are very small. The dental formula is: i. 3/3; c. 1/1; pm. 3/4; m. 2/2 = 38. The molars are massive and have many cusps.

Chiefly arboreal, lesser pandas are somewhat nocturnal, sleeping during the day in tree holes. Vegetable matter such as bamboo sprouts, grass roots, fruits and oak mast comprise the diet. Mating takes place in December and January and the gestation period is approximately 90 days. Young, usually

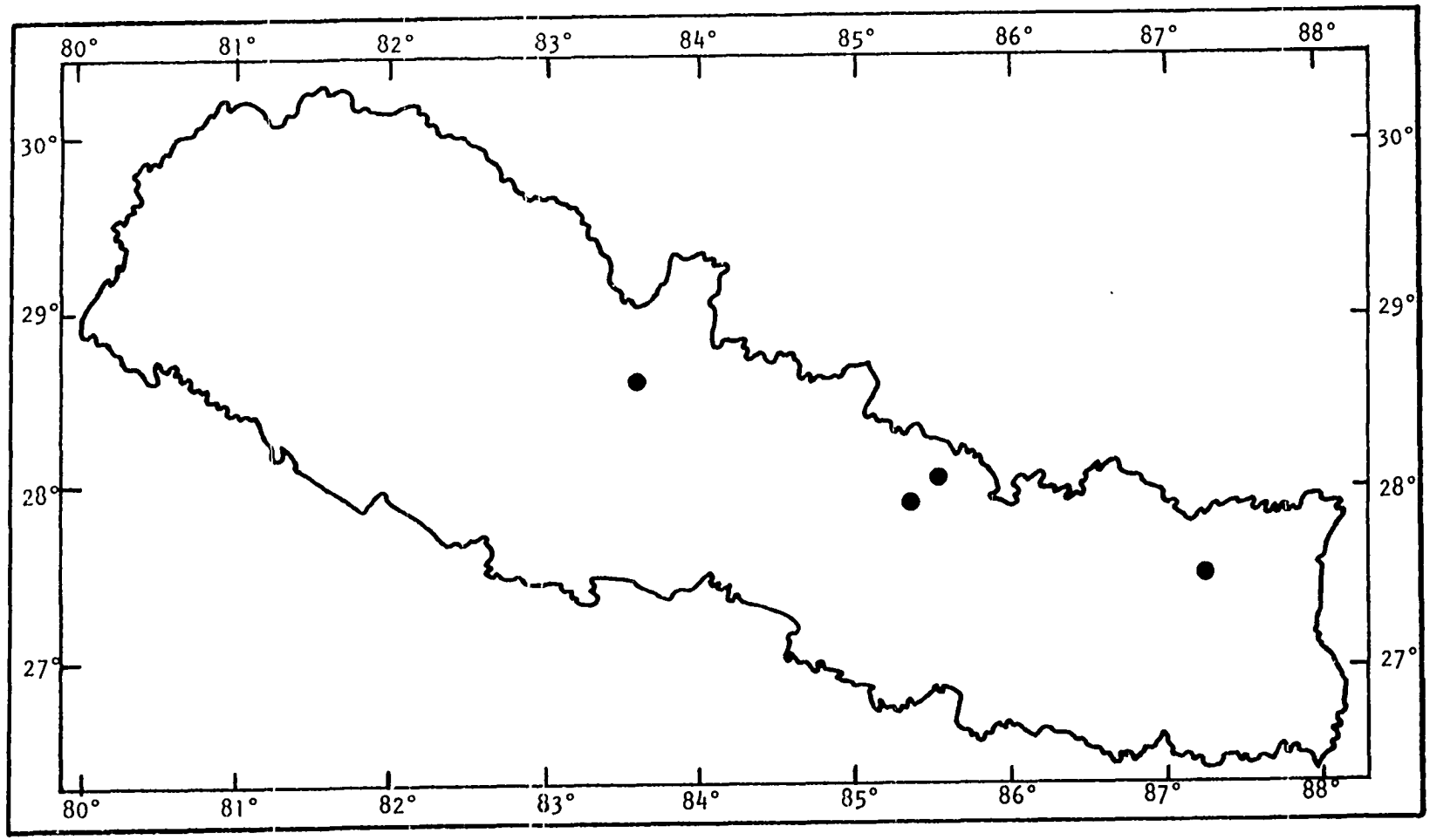


Fig. 56. Sightings for Ailurus fulgens

two in number, are born the following spring.

In September, 1969, local hunters from Belumche, Sindu District, captured a female. When provoked she would hiss and emit a musky scent from the anus. According to Pocock (1939), there is a large pair of anal glands. In January, 1970, a large male was captured near Melumche, Sindu District. On 23 February 1970, two skins were seen in a local bazaar at Dana, Mustang District; one was purchased. These animals are easily tamed and are sometimes kept as pets.

Martes foina intermedia (Severtzov, 1873)

Beech Marten or Stone Marten

1873. Mustela intermedia Severtzov. Mem. Soc. Amis. Sci. Nat. Moscow 8(2): 61.

Type locality: Eastern Turkestan: Basin of the Chu, Tallas, and Naryn.

1879. Martes leucolachnaea Blanford. Second Yarkand Miss. Mamm. p. 26.

Type locality: Yarkand, Chinese Turkestan.

1891. Mustela foina Blanford. The Fauna Brit. India, Mamm. p. 160.

1914. Martes foina altaica Satunin. Conspectus Mamm. Ross. 1: 111.

Type locality: Altai.

1919. Martes toufoeus Wroughton. J. Bombay Nat. Hist. Soc. 26(2): 343.

Type locality: Siling, Tibet.

1941. Martes foina intermedia (Severtzov), in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 322.

Distribution: Russian and Chinese Turkestan, Altai, Tianshan, Afghanistan, Baluchistan, Kashmir, Nepal, Tibet, Upper Sikkim.

Nepal Records: Biswas and Khajuria (1957, p. 235).

Habitat: The coniferous and rhododendron forests of the inner Himalayas.

Field Notes: The beech marten has a long, slender body and short limbs. The tail is about two-thirds the length of the head and body. The head and body length is 400 to 460 mm and the tail length 230 to 260 mm. The guard hairs are brown with light brown underfur. The throat and chest are white. The underparts vary from ashy to pure white.

Beech martens are generally solitary and are active both day and night. They remain active all winter and only den up for short periods during extreme cold weather. These martens are largely arboreal and feed chiefly upon birds or small mammals; carrion, insects and fruit are also part of their diet.

Mating takes place in May and the gestation period is about 220 days. The long gestation period is due to delayed implantation. Ova lie dormant in the uterus for some time after fertilization and are not implanted until four to five weeks before birth (Walker et al. 1964b). The number of young in each litter is usually four to five.

Biswas and Khajuria (1957) reported the beech marten

from Nepal for the first time. Blanford (1891) recorded collections of them from both sides of Nepal, Kumaon and Sikkim.

Martes flavigula flavigula (Boddaert, 1785)

Yellow-throated Marten

1785. Mustela flavigula Boddaert. Elench. Anim. p. 88.

Type locality: unknown, traditionally fixed as Nepal (Pocock).

1792. Mustela melina Kerr. Anim. Kingd. p. 183.

1800. Mustela leucotis Bechstein. Uebers. vierf. Thiere. 2: 375.

1800. Viverra quadricolor Shaw. Gen. Zool. Mamm. Vol. 1 (part 2), p. 429.

1834. Mustela hardwickei Horsfield. Zool. Journ. 4: 239. pl. 8.

Type locality: Nepal.

1842. Galidictis chrysogaster H. Smith. Jardine's Nat. Lib. 35, Mamm. 1: 167.

Type locality: Mussoorie, Northern India.

1846. Martes flavigula Gray. Cat. Hodgson's Coll. B. M. p. 12.

Type locality: Nepal.

1901. Mustela flavigula typica Bonhote. Ann. Mag. Nat. Hist. 7: 343.

1901. Mustela flavigula kuatunensis Bonhote. Ann. Mag. Nat. Hist. 7: 348.

Type locality: Kuatun, northwestern Fukien, southern China.

1910. Mustela flavigula szetchuensis Hilzheimer. Zool. Anz. 35: 310.

Type locality: Sungpanting, Szechuan, China.

1919. Martes flavigula flavigula (Boddaert), in Wroughton. J. Bombay Nat. Hist. Soc. 26(2): 343.

1923. Charronia flavigula Hinton and Fry. J. Bombay Nat. Hist. Soc. 29(2): 414.

Type locality: Nepal.

1941. Charronia flavigula flavigula Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 331.

Type locality: Nepal.

Distribution: Kashmir eastward through the Himalayas, Mussoorie, Kumaon, Nepal, Sikkim to southern China.

Nepal Records: Hodgson (1834b, p. 97), Gray (1846, p. 12), Hinton and Fry (1923, p. 414), Fry (1925, p. 528), Pocock (1941, p. 331), Biswas and Khajuria (1957, p. 236), Chesemore (1970, p. 165).

NEP: 6 specimens: Mitchell - 4; AVWE - 2.

Habitat: Evergreen oak and coniferous forests of the Mahabharat Lekh and midlands, subalpine and alpine biotopes of the inner Himalayas; from 1500 to 4200 m.

Taxonomic Notes: Pocock (1941) based his placement of flavigula in a separate genus of its own, Charronia, on the difference in the structure of the baculum from that of other martens. Ellerman and Morrison-Scott (1966) treat Charronia as a subgenus of Martes.

Field Notes: The yellow-throated marten is one of the largest members of the genus. It has a long heavy body, a long cylindrical tail and a striking yellow and black color pattern. The upper part of the head is glossy, blackish brown, the neck is white and the chest golden yellow. The anterior portion of the back has a considerable amount of yellow intermingled with black, the posterior part is brownish black. The limbs and tail are black with a brown tinge.

Yellow-throated martens occupy a number of different biotopes, chiefly forested, mountainous country. Pocock (1941) recorded the altitudinal range as 180 to 3330 m. Chesemore (1970) reported sighting a group of these martens in the mixed forest zone of Birganj District (200 m). Prater (1965) stated that in the Himalayas they reside in the temperate forest belt between 1220 and 2745 m and are not found above treeline. He also stated that they hunt and live alone.

Their dietary habits are varied; they prey on birds, small mammals and rodents and they also feed on eggs, insects and carrion. Little has been recorded about their breeding habits, which are probably similar to those of the beech marten. They probably have litters from February through April, with a litter size of two to five.

Martens were encountered throughout the midlands and inner Himalayas, but never below 2100 m. They were sighted

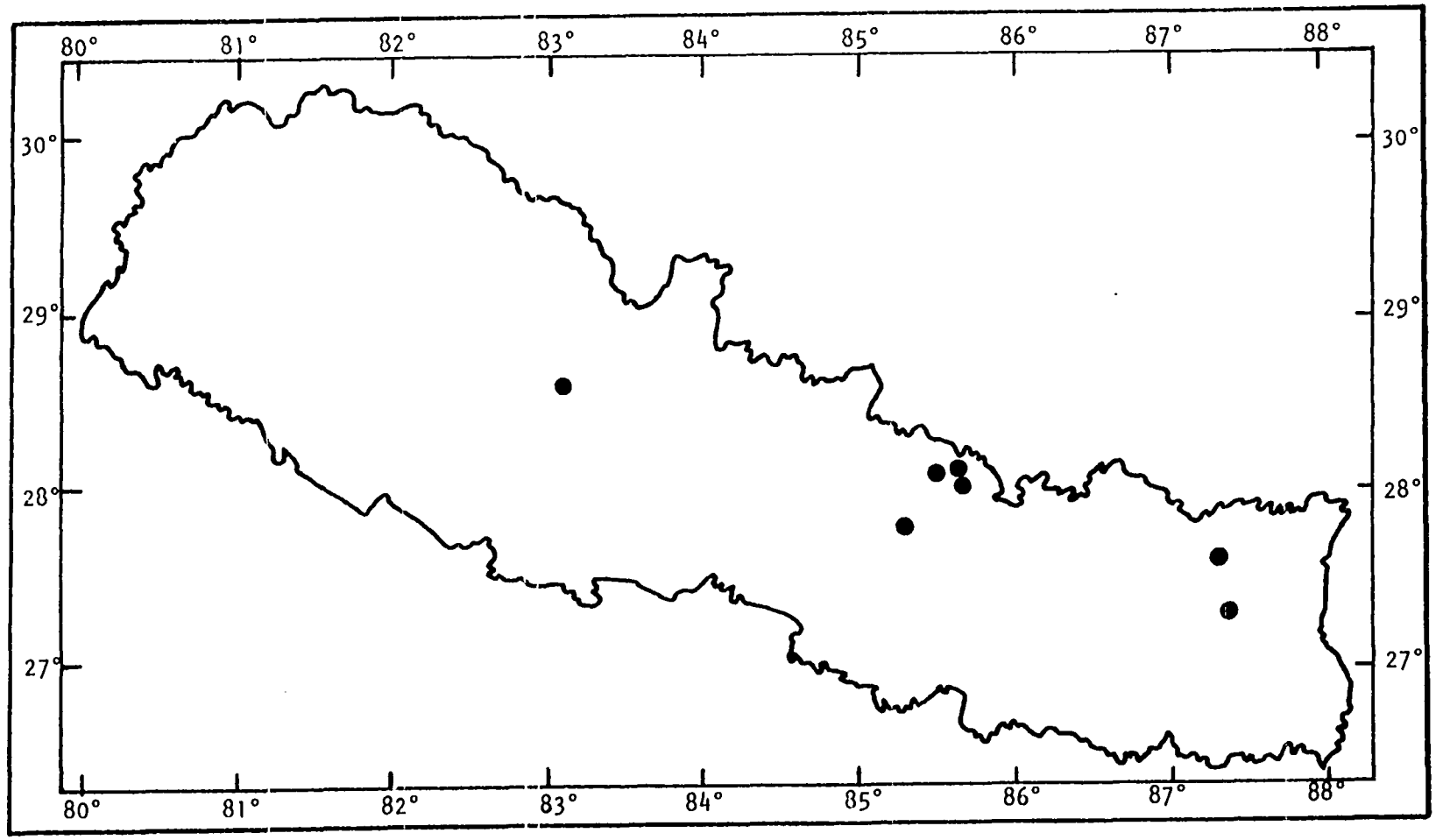


Fig. 57. Collection sites for Martes flavigula

at Gosainkund Lakes, Nuwakot District, which is at least 900 m above tree line. They almost always hunt in pairs; only twice were single individuals encountered. In the alpine regions, they were observed actively hunting for Ochotona among boulder piles. At Jumla, a marten was sighted foraging about in a pine tree. Specimens were collected by trapping and shooting. A covey set of steel traps with a dead grouse staked in the center proved an effective method of capturing these animals.

ECTOPARASITES

Siphonaptera:	Ctenophyllus n. sp. Macrostylophora lupata Paraceras sauteri
Ixodoidea:	Ixodes tanuki Rhipicephalus haemaphysaloides
Mallophaga:	Trichodectes sp.

Mustela altaica temon Hodgson, 1857

Alpine Weasel

1857. Mustela temon Hodgson. J. Asiat. Soc. Bengal 26: 207.

Type locality: Sikkim.

1863. Mustela (Putorius) temon Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 7.

Type locality: Sikkim.

1891. Putorius alpinus Blanford. The Fauna Brit. India, Mamm. p. 168.

1911. Mustela longstaffi Wroughton. J. Bombay Nat. Hist. Soc. 20(4): 931.

Type locality: Teza, Upper Sutlej Valley, northern India.

1941. Mustela altaica temon Hodgson, in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 352.

Distribution: The Himalayas, Sikkim to Gilgit.

Nepal Records: Biswas and Khajuria (1957, p. 237).

NEP: 1 specimen: Mitchell - 1.

Habitat: Alpine desert biotope of the Mustang District, alpine region of the inner Himalayas; from 3000 to 4400 m.

Field Notes: The alpine weasel has a slender body and short legs. The color of the back and sides is light brown; the underparts are yellow or yellowish white. The tail is colored like the body. The head is dark brown and the chin and forefeet are white.

The muzzle is short and the skull is elongate behind the orbits. They have one less premolar in each jaw than martens. The dental formula is: i. 3/3; c. 1/1; pm. 3/3; m. 1/1 = 34 (Allen 1938).

Alpine weasels feed on rats, mice, birds and other small prey. Litters of five to seven are produced twice a year and the gestation period is 40 to 45 days.

Biswas and Khajuria (1957) were the first to collect this species from Nepal. They trapped five specimens from Solukhumbu District. A single specimen was collected by the

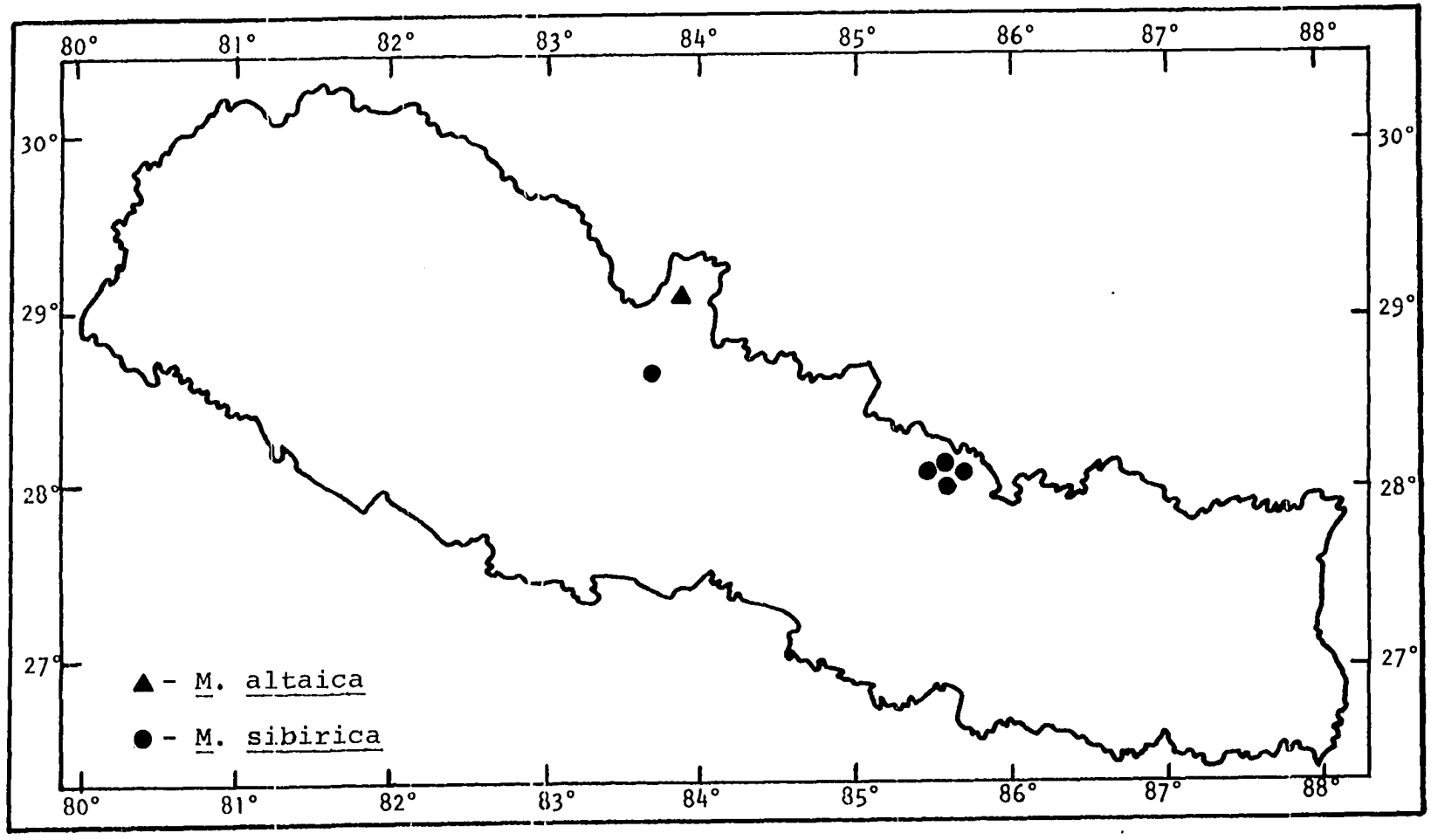


Fig. 58. Collection sites for Mustela sp.

NEP from Mustang, Mustang District at 3700 m.

ECTOPARASITES

Siphonaptera: Callopsylla kaznakovi
Paradoxopsyllus acanthus

Mustela kathiah kathiah Hodgson, 1835

Yellow-bellied Weasel

1835. Mustela (Putorius) kathiah Hodgson. J. Asiat. Soc. Bengal 4: 702.

Type locality: The Kachar, northern region of Nepal.

1837. Mustela (Putorius) auriventer Hodgson. J. Asiat. Soc. Bengal 6: 563.

1846. Mustela cathia vel. auriventer Gray. Cat. Hodgson's Coll. B. M. p. 13.

1891. Putorius cathia Blanford. The Fauna Brit. India, Mamm. p. 169.

1923. Mustela kathiah Weigold. Abh. Ber. Mus. f. Tier u. Volkerk. 16(2): 73.

1938. Mustela altaica kathiah Allen. The Mamm. China and Mongolia. Vol. 11 (part I), p. 381.

Type locality: Nepal.

Distribution: The Himalayas, from Mussoorie, Nepal eastward to Assam, Upper Burma, Fukien, Szechuan.

Nepal Records: Hodgson (1835b, p. 702), Gray (1846, p. 13), Hinton and Fry (1923, p. 414), Allen (1938, p. 381), Worth and Shah (1969, p. 126).

Habitat: The temperate forests of the midlands from

1800 to 3000 m; the subalpine and alpine regions of the inner Himalayas from 3000 to 4000 m.

Discussion: Allen (1938) stated that M. kathiah and M. altaica are similar in size and cranial measurements, but differ slightly in coloration. He, therefore, treated kathiah as a subspecies of M. altaica. Pocock (1941) and Ellerman and Morrison-Scott (1966) chose to retain kathiah as a valid species.

The back, face and upper surface of the head and the ears, legs and tail are dark brownish red. The lower parts are a deep yellow, which extends to the inside of the limbs. The tail is more than half and sometimes nearly two-thirds the length of the head and body. The head and body length is 250 to 270 mm and the tail length 125 to 150 mm.

Little is known about yellow-bellied weasels. They inhabit pine forests and also occur above treeline. They feed on rodents, birds and small mammals.

On 18 October, 1968, at Khumjung, Solukhumbu District (3560 m), this weasel was seen eating a rat that had been caught in a trap.

Mustela sibirica subhemachalana Hodgson, 1837

Himalayan Weasel

1837. Mustela (Putorius) subhemachalanus Hodgson. J. Asiat. Soc. Bengal 6: 563.

Type locality: Nepal.

1847. Mustela humeralis Blyth. J. Asiat. Soc. Bengal 11: 99.

Type locality: Sikkim.

1843. Mustela horsfieldi Gray. Ann. Mag. Nat. Hist. 11: 118.

Type locality: Bhutan.

1891. Putorius subhemachalanus Blanford. The Fauna Brit. India, Mamm. p. 166.

1941. Mustela sibirica subhemachalana Hodgson, in Pocock. Fauna Brit. India, Mamm. Vol. 2, p. 365.

Mustela sibirica canigula Hodgson, 1842

White-nosed Weasel

1842. Mustela canigula Hodgson. J. Asiat. Soc. Bengal 11: 279.

Type locality: Lhasa, Tibet.

1843. Mustela hodgsoni Gray. Ann. Mag. Nat. Hist. 11: 118.

Type locality: Himalayas.

Distribution: Kashmir to Bhutan, Tibet.

Nepal Records: Hodgson (1837b, p. 563), Gray (1846, p. 13), Hinton and Fry (1923, p. 414), Fry (1925, p. 528), Biswas and Khajuria (1957, p. 237), Worth and Shah (1969, p. 126).

NEP: 12 specimens: Mitchell - 9; Maser - 3.

Habitat: Temperate forests of the midlands; coniferous

forests and alpine meadows of the inner Himalayas; from 2400 to 4000 m.

Taxonomic Notes: Two subspecies of the Siberian weasel, subhemachalana and canigula, occur in Nepal. Gray (1843) and Pocock (1941) recognized a third subspecies, hodgsoni. According to these authors, M. s. hodgsoni is distinguished from M. s. canigula by the smaller amount of white on the muzzle and the stark hue of the head. Blanford (1891) contended that M. s. hodgsoni was synonymous with M. s. canigula.

Field Notes: The Himalayan weasel is medium-sized with a long body, short limbs and a tail about 40% of the head and body length. The color ranges from brownish red to bright chestnut or bay. The tip of the nose and tail is dark, but not black. The chin is white and in some specimens there are white spots or patches on the chest. M. s. canigula differs from M. s. subhemachalana in the color of the face. The muzzle is white as far back as the eyes which are not encircled with brown; the throat is also more extensively white (Pocock 1941). There are four pairs of mammae.

Himalayan weasels are aggressive, preying on rodents, lagomorphs, birds and reptiles. They also raid chicken and pigeon coops. Little is known about their breeding biology. Mating probably takes place in February and March with young born in May. In August, 1969, a single lactating female was

collected.

Nine specimens were trapped from the subalpine and alpine regions of the midlands, none were taken below 3000 m. On numerous occasions these weasels were seen on talus slopes hunting for pikas. One specimen of M. s. canigula was seen foraging about in a stone fence at Maharigaon, Jumla District.

ECTOPARASITES

Siphonaptera:	Amphalius clarus Chaetopsylla homoea homoea Ctenophyllus n. sp. Neopsylla secura
Ixodoidea:	Ixodes tanuki
Parasitoidea:	Haemogamasus nidiformis
Mallophaga:	Strachiella mustelae

Mustela strigidorsa Gray, 1853

Back-striped Weasel, Striped Weasel

1853. Mustela strigodorsa Gray (Hodgson MS). Proc. Zool. Soc. London. p. 191.

Type locality: Sikkim.

1855. Mustela strigidorsa Horsfield. Ann. Mag. Nat. Hist. 16: 107.

Type locality: Sikkim hills.

1891. Putorius strigidorsus Blanford. The Fauna Brit. India, Mamm. p. 170.

Distribution: Nepal, Sikkim, Bhutan, Assam, Upper Burma.

Habitat: Temperate forests of the eastern midlands.

Discussion: The striped weasel is similar in size to the Himalayan weasel, but has a longer tail (50% of the head and body length) and thicker fur. The color is deep bay (dark brownish red) throughout with the exception of yellow on the throat and the middle of the breast. A narrow whitish line extends down the middle of the back and another along the venter. Four pairs of subinguinal mammae are present (Blanford 1891). The head and body length is 250 to 300 mm, the tail length 130 to 160 mm.

Striped weasels live in evergreen forests ranging between 1200 and 2200 m. They are rare and little is known about the life history. Their biology is probably similar to that of other mustelids of the Himalayas.

Blanford (1891), Pocock (1941) and Ellerman and Morrison-Scott (1966) listed the western-most range of this species as Nepal, but no striped weasels were encountered in the field. There are no records from within the country.

Mellivora capensis inaurita (Hodgson, 1836)

Ratel or Honey Badger

1836. Ursitaxus inauritus Hodgson. Asiat. Res. 19(1): 61.

Type locality: Muckwanpur, in foothills of southern Nepal. (Makwanpur).

1846. Melivora ratel Gray. Cat. Hodgson's Coll. B. M. p. 13.

Type locality: Lower hilly region, Nepal.

1863. Mellivora ratel Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 7.

Type locality: Nepal.

1941. Mellivora capensis inaurita (Hodgson), in Pocock. Fauna Brit. India, Mamm. Vol. I, p. 461.

Distribution: Lower hilly regions, Nepal.

Nepal Records: Hodgson (1834b, p. 96; 1836a, p. 61), Gray (1846, p. 13; 1863b, p. 7).

Habitat: The lower hilly regions of the Siwalik and Mahabharat Ranges in moist deciduous forests.

Discussion: Ratels are heavy bodied animals with short legs and a relatively short tail. The ears are small and the muzzle is not snout-like. The forefeet are large and armed with very large and strong claws. The skin is exceedingly loose on the body and is extremely tough. The hair is coarse and is quite scanty on the underparts. The upper surface from the top of the head to the base of the tail varies from gray to pale yellow or whitish. It contrasts sharply with the dark brown or black of the face, chin and underparts. Anal glands are well-developed with an opening on each side of the anus. The number of mammae is four. The head and body length is 600 to 770 mm, the tail length 200 to 300 mm and the weight 8 to 10 kg.

Honey badgers are found in a number of different

habitats from the Terai to the broken, hilly country of the Siwalik range. They live in hollow trees and burrows. Strictly nocturnal, they remain in burrows during the day. Blanford (1891) stated that they live in pairs and feed on rats, birds, frogs and insects. They are extremely destructive to poultry. Other items of their diet include snakes, lizards, carrion and plant matter. Their fondness for honey accounts for their common name, "honey badger". Little is known about their reproductive biology. Prater (1965) listed a gestation period of six months and a litter size of two.

Gray (1846) reported the last collection of the ratel from Nepal. The type specimen was collected from Makwanpur, Makwanpur District, by Hodgson (1836a). In 1966, Maser collected extensively throughout the Hitaura District, which lies 10 to 12 km west of Makwanpur. He did not collect or report any such animal from the area. The destruction of much of the original habitat of the lower foothills could have affected the present distribution of the ratel.

Melogale personata nipalensis (Hodgson, 1836)

Ferret-badger

1836. Gulo nipalensis Hodgson. J. Asiat. Soc. Bengal 5: 237. Type locality: Banks of the Rapti River, Nepal.

1846. Helictes nipalensis Gray. Cat. Hodgson's Coll. B. M. p. 14.

Type locality: Nepal.

1891. Helictes orientalis Blanford. The Fauna Brit. India, Mamm. p. 173.

1923. Melogale nipalensis Hinton and Fry. J. Bombay Nat. Hist. Soc. 29(2): 415.

1941. Helictis personata nipalensis Pocock. The Fauna of Brit. India, Mamm. Vol. 2, p. 410.

Type locality: Nepal.

1966. Melogale personata nipalensis (Hodgson), in Ellerman and Morrison-Scott. Checklist Palaearctic and India Mamm. 2nd ed. p. 270.

Distribution: Nepal to Bhutan Duars.

Nepal Records: Hodgson (1836c, p. 237), Gray (1846, p. 14), Hinton and Fry (1923, p. 415), Pocock (1941, p. 410).

Habitat: The Rapti Dun and the Siwaliks, also deciduous forests of the midlands; 200 to 2000 m.

Discussion: Ferret-badgers resemble weasels, but are somewhat more heavily built with strong foreclaws and a more developed cartilaginous snout. They are distinguished from other Oriental mustelids by the black and whitish or black and yellowish mask. A reddish white dorsal stripe is usually present on the pale to dark brown back. The underparts are somewhat paler. The bushy tail is the same color as the back. There are four inguinal mammae. The head and body length is 330 to 430 mm, the tail length 150 to 230 mm and the weight 1 to 2 kg.

The dental formula is: i. 3/3; c. 1/1; pm. 4/4; m. 1/2 = 38. The large fourth premolar has an internal lobe

which is very wide with a strong, erect cusp. The lower carnassial (M_1) has a well-developed anterior trigon. The last molar is very small (Allen 1938).

Ferret-badgers inhabit the temperate forests of the Himalayan foothills. They are nocturnal, sleeping in burrows and natural shelters during the day. These animals are omnivorous; they feed on fruit, insects, lizards, birds and small mammals.

The young, usually one to three per litter, are born in a burrow during May and June. Allen (1938) collected a female on 6 June with two one-third grown young. Another female with two young was taken in late May.

These mustelids are infrequently encountered. According to Hodgson (1836c), the type specimen was collected from the "banks of the Rapti". Chesemore (1970) collected mammals for 18 months in the Rapti region and did not report the ferret-badger in his checklist. There have not been any reports of this species from Nepal since Hodgson in 1836.

Arctonyx collaris collaris F. Cuvier, 1825

Hog-badger

1825. Arctonyx collaris F. Cuvier. Hist. Nat. Mamm. 3(51): pl. 220.

Type locality: Bhutan Duars.

1853. Arctonyx taxoides Blyth. J. Asiat. Soc. Bengal 22: 591.

Type locality: Assam.

1856. Arctonyx isonyx Horsfield (Hodgson MS). Proc. Zool. Soc. London. p. 398.

Type locality: Sikkim Terai.

1863. Arctonyx collaris taraiyensis Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 7.

Type locality: Sikkim Terai.

Distribution: The base of the eastern Himalayas: Nepal, Sikkim Terai, Bhutan Duars, Assam.

Nepal Records: Biswas and Khajuria (1957, p. 238).

Habitat: Undulating, stony ground or small hills in the jungles of the Terai and Siwalik foothills.

Discussion: The hog-badger has a stout body and limbs and a short tail. The snout is long, mobile and naked towards the end. The rounded ears are very small. The hair is coarse and long with woolly underfur. The back is yellowish gray to blackish. There is a pattern of white and black stripes on the head, the dark stripes running through the eyes and bordered by white stripes which merge on the nape. The throat, ears and tail are white and the feet and belly are black. Three pairs of mammae are present. The length of the head and body is 550 to 700 mm, the length of the tail 120 to 170 mm and the weight 7 to 14 kg.

The dental formula is: i. 3/3; c. 1/1; pm. 3/3; m. 1/2 = 34 (Allen 1938). The infraorbital foramen is very long and the auditory bullae are quite small. The anterior

premolars in both jaws are often rudimentary or lacking. The upper incisors are arranged in a semi-circle.

Hog-badgers frequent the lower foothills of the Himalayas. Nocturnal, they spend the day in natural shelters or deep burrows. They root with their snouts for animal and plant foods. According to Prater (1965), they feed on small mammals, birds, reptiles, fruit, vegetables and earthworms. The reproductive biology is not well-known. A female hog-badger collected from northern China in April had four newly born young (Walker et al. 1964b).

The purchase by Biswas and Khajuria (1957) of a skin of an unsexed specimen from eastern Nepal was the first apparent record of the hog-badger from the country. The normal range of this species is the Bhutan Duars and Sikkim Terai, and the skin could have been imported from these countries.

Lutra lutra aurobrunnea Hodgson, 1839

Himalayan Otter

1839. Lutra aurobrunneus Hodgson. J. Asiat. Soc. Bengal 8: 320.

Type locality: Nepal.

1846. Lutra aurobrunnea Gray. Cat. Hodgson's Coll. B. M. p. 14.

Type locality: Nepal.

1865. Barangia nepalensis Gray. Proc. Zool. Soc. London. p. 124.

Type locality: Nepal.

1867. Lutra vulgaris Jerdon. The Mamm. of India. p. 88.

1941. Lutra lutra aurobrunnea Hodgson, in Pocock. Fauna of Brit. India, Mamm. Vol. 1, p. 282.

Distribution: Nepal (high altitudes).

Nepal Records: Hodgson (1839b, p. 320), Gray (1846, p. 14; 1865, p. 124), Chesemore (1970, p. 165).

NEP: 2 skins (purchased): Mitchell - 2.

Habitat: High mountain streams of subalpine and alpine valleys, 2400 to 4300 m.

Taxonomic Notes: Hodgson (1839b) described a new species of otter, Lutra aurobrunneus, from the high mountain streams of the Nepal Himalayas. The specific name was later changed to aurobrunnea (Gray 1846).

Gray (1865) described a new species, Barangia nepalensis, based on a single skull of an otter collected by Hodgson. Barangia is a genus based on the hairy-nosed Malay otter, Barangia sumatrana Gray, 1865. Pocock (1941) questioned the validity of B. nepalensis, for it was based on a damaged skull without an accompanying skin. He therefore treated it as a synonym of L. aurobrunnea.

Field Notes: In the Himalayan otter, the head is broad and somewhat flattened, the neck thick and the trunk cylindrical. The tail is long, muscular and flexible,

tapering slightly toward the end. The legs are short and the toes webbed. The fur is short and dense, with a fine undercoat. Dorsally the color is a rich chestnut brown and the venter and extremities are golden red. Blanford (1891) reported the following measurements for this species: Head and body - 500 to 550 mm, tail - 300 to 350 mm and weight - 4 to 6 kg. The dental formula is: i. 3/3; c. 1/1; pm. 4/3; m. 1/2 = 36.

This otter is found in the streams of the middle Himalayas. Nothing is known about its breeding biology and habits. They are probably similar to those of other Oriental otters.

Gray (1846) listed the last collection of L. l. aurobrunnea from the area. Chesemore (1970) reported skins of an otter being sold in a small shop at Jomosom, Mustang District at 2730 m. Locals said they trapped these otters from mountain streams in the area. Two skins of a small, light chestnut brown otter were bought from natives at Langtang Valley, Rasuwa District at 3640 m. There were no skulls accompanying the skins. These skins may be those of the Himalayan otter. There are no reports of other species of otters occurring at such high altitudes.

Lutra perspicillata perspicillata Geoffroy, 1826

Smooth-coated Indian Otter, Smooth Indian Otter

1826. Lutra perspicillata Geoffroy. Dict. Class Nat. Hist. 9: 519.

Type locality: Sumatra.

1827. Lutra simung Lesson. Man. Mamm.: 156.

Type locality: Sumatra.

1839. Lutra tarayensis Hodgson. J. Asiat. Soc. Bengal 8: 319.

Type locality: Nepal Terai.

1865. Lutra macrodus Gray. Proc. Zool. Soc. London: 128.

Type locality: Madras.

1879. Lutra ellioti Anderson. Zool. Res. Yunnan. p. 212.

Type locality: Madras, India.

1923. Lutragale barang tarayensis Hinton and Fry. J. Bombay Nat. Hist. Soc. 29(2): 416.

Type locality: Nepal Terai.

1941. Lutrogale perspicillata Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 293.

Distribution: India, from Madras to the lower Himalayas, Nepal Terai, Burma, Indo-China, Sumatra.

Nepal Records: Hodgson (1839b, pp. 319-320), Gray (1846, p. 14; 1863b, p. 7), Hinton and Fry (1923, p. 416).

NEP: 2 sightings: Mitchell - 2.

Habitat: Larger rivers of the Terai and duns, 100 to 700 m.

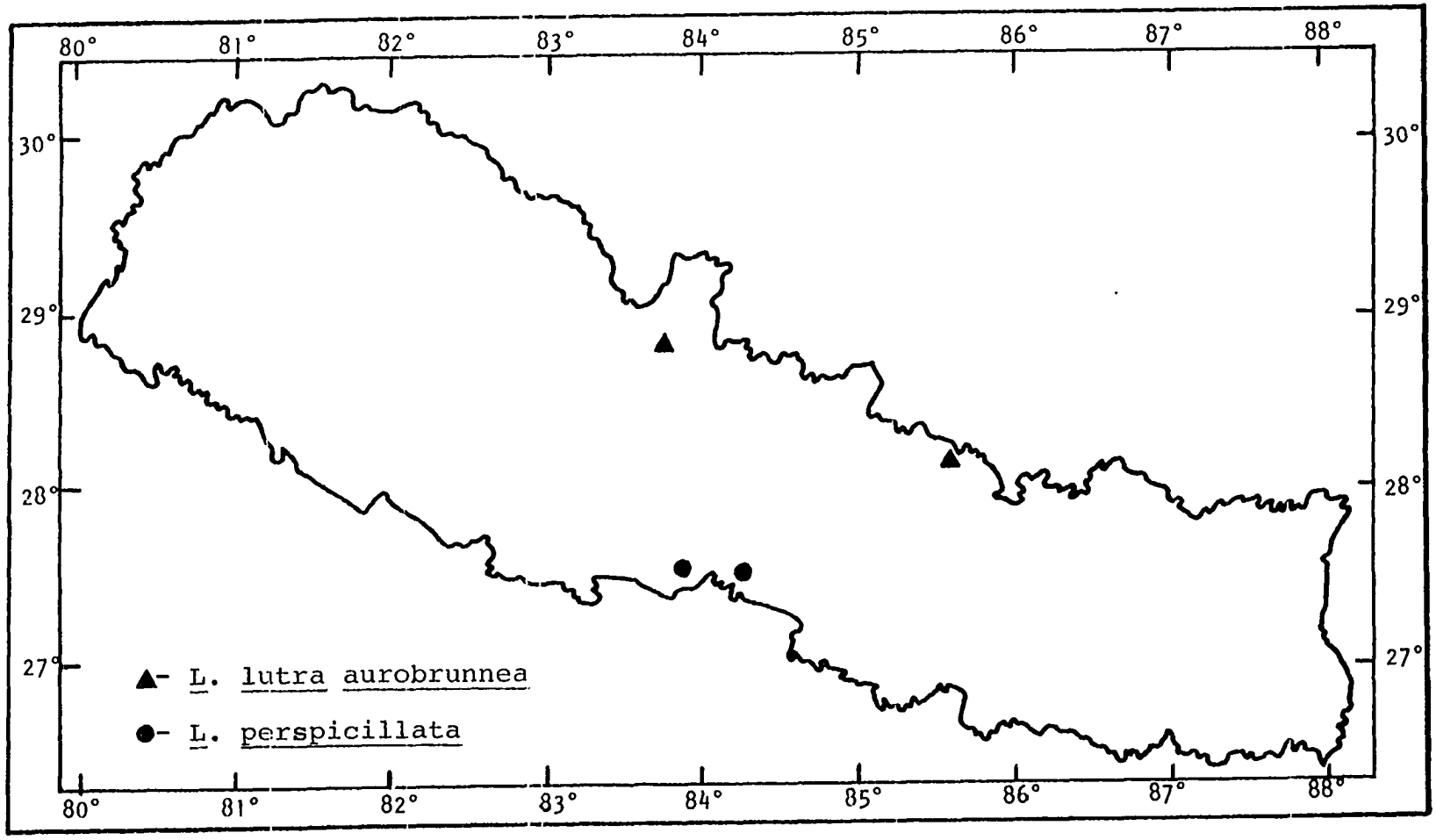


Fig. 59. Sightings for Lutra sp.

Taxonomic Notes: Pocock (1941) placed perspicillata in the genus Lutrogale. He contended that Lutrogale is distinguished from Lutra by the structure of the skull, which is less depressed, with larger orbits and a reduced muzzle.

Field Notes: The Indian smooth otter is heavily-built with a smooth, sleek coat. The upper border of the naked nose-pad forms a straight, transverse line. The color varies from blackish to rufous chocolate brown or sometimes sandy or tawny brown. The dorsal fur is not grizzled. The chin and edge of the lips are whitish, and the sides of the head, throat and under surface of the neck and chest are silvery hoary. The head and body length is 650 to 750 mm, the tail length 400 to 450 mm and the weight 7 to 11 kg.

The distinctive features of the skull are: (1) the considerable swelling of the postorbital constriction of the frontal; (2) the nearly straight rather than depressed profile of the rostrum and (3) the long, narrow and parallel-sided postorbital region (Allen 1938).

These otters inhabit streams and rivers of the Terai, ascending into the Siwalik hills and the Rapti Dun. They are active both day and night and hunt singly or sometimes in pairs. The diet consists of frogs, turtles, fish and aquatic invertebrates. Birds and land mammals are also preyed upon. They show a ready adaptability to changing conditions--during dry periods they take to jungle hunting like other land

carnivores. The gestation period is reported to be about two months and the litter, born during February and March, is made up of one to five young.

On 24 January, 1968, six smooth otters were seen playing along the banks of the Rapti River, Chitwan District. On 15 February, 1968, another party of otters was seen swimming in the Narayani River, Tamispur, Nawal Parasi District. Natives report sighting this otter in rivers throughout the Terai and Rapti Dun.

Aonyx cinerea concolor (Rafinesque, 1832)

Small-clawed Otter

1832. Amblonyx concolor Rafinesque. Atlantic Journ. 1: 62.

Type locality: Garo Hills, Assam.

1839. Lutra indigitatus Hodgson. J. Asiat. Soc. Bengal 8: 320.

Type locality: Nepal.

1846. Aonyx indigitatus Gray. Cat. Hodgson's Coll. B. M. p. 14.

Type locality: Nepal.

1855. Aonyx sikimensis Horsfield (Hodgson MS). Ann. Mag. Nat. Hist. 16: 109.

Type locality: Sikkim.

1867. Lutra leptonyx Jerdon. The Mamm. of India: 89.

1867. Lutra (Hydrogale) swinhoei Gray. Proc. Zool. Soc. London. p. 182.

Type locality: Gawkang Island, Amoy, Fukien, southern China.

1870. Aonyx leptonyx Horsfield, in Swinhoe. Proc. Zool. Soc. London. p. 229.

Type locality: Hainan, China.

1879. Lutra (Aonyx) leptonyx Anderson. Anat. and Zool. Researches Western Yunnan. p. 213.

Type locality: western Yunnan.

1920. Amblonyx cinerea fulvus Pohle. Arch. Nat. 85(9): 133.

Type locality: Lao Key, Tonkin, Indo-China.

1938. Micraonyx cinerea Allen. The Mamm. of China and Mongolia. Vol. 11 (part I), p. 416.

Type locality: western Yunnan.

1940. Amblonyx cinerea concolor Pocock. J. Bombay Nat. Hist. Soc. 41(3): 514.

1966. Aonyx cinerea concolor (Rafinesque), in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 279.

Distribution: Throughout the Himalayas from Kumaon to Upper Burma, Assam, Indo-China; southern China from Yunnan eastward to the Pacific coast in Fukien Province and Hainan.

Nepal Records: Hodgson (1839b, p. 320), Gray (1846, p. 14), Hinton and Fry (1923, p. 416).

Habitat: Streams of the lower and central hilly regions of the Siwaliks and Mahabharats from 300 to 1500 m.

Discussion: The small-clawed otter is distinguished from other otters by its rudimentary claws, which do not project beyond the ends of the digital pads. Also the webbing on the feet does not extend along the digital pads. The color

is dark brown above, with an occasional gray or ashy tint. The underparts are pale brown, the throat grayish or whitish. The head and body length is about 610 mm, the tail length 305 mm and the weight 2.7 to 5.4 kg (Walker et al. 1964b).

The skull is small with a very short rostrum. The postorbital processes are prominent and the postorbital constriction is deep. The brain case is broad anteriorly and the teeth are very large. The dental formula is: i. 3/3; c. 1/1; pm. 3/3; m. 1/2 = 34. In each side of the upper jaw there is usually one less premolar than in Lutra (Allen 1938).

Small-clawed otters are found throughout the Himalayas at lower elevations. They occur singly, in pairs, or sometimes in families of five or six. They hunt in streams, rivers and flooded rice paddies. Generally nocturnal, they are also active throughout the day. Members of this genus are chiefly crab-eaters, but they also feed on mollusks, fish, frogs, lizards, aquatic birds and small mammals. Two to five young are born after a gestation period of 60 to 65 days. Most young are born in the spring. The young remain with the parents for at least one year (Walker et al. 1964b)

Viverra zibetha zibetha Linnaeus, 1758

Large Indian Civet

1758. *Viverra zibetha* Linnaeus. Syst. Nat. 10th ed. Vol. 1, p. 44.

Type locality: Bengal.

1830. *Viverra undulata* Gray. Spic. Zool. 2: 9, pl. 8.

Type locality: Nepal.

1841. *Viverra civettoides* Hodgson. J. Asiat. Soc. Bengal 10: 909. (*nom. nud.*)

Type locality: Nepal.

1842. *Viverra orientalis* Hodgson. Calcutta J. Nat. Hist. 2: 47.

Type locality: Nepal.

1933. *Viverra zibetha zibetha* Linnaeus, *in* Pocock. J. Bombay Nat. Hist. Soc. 36(2): 428.

Distribution: Nepal, Darjeeling, Sikkim, Bhutan, Bangladesh, Assam.

Nepal Records: Hodgson (1834b, p. 96; 1841e, p. 919; 1842c, p. 47), Gray (1846, p. 7), Hinton and Fry (1923, p. 411), Fry (1925, p. 527).

NEP: 3 specimens: AVWE - 2; Maser - 1; Mitchell - 2 sightings.

Habitat: Jungle, grasslands and temperate broadleaf forests of the Terai, duns and lower foothills of the midlands, 100 to 2700 m.

Field Notes: The large Indian civet is sturdily built, with a long head, a long compressed body, and short, stumpy legs. Its large size, full black and white ringed tail, blackish feet and a broad black band on the lower throat set off by transverse areas of white make it easy to recognize. An erectile crest of long black hair runs down the center of the back. The feet are armed with small, blunt, partially retractile claws. There are three pairs of mammae. The head and body length is 600 to 800 mm, the tail length 300 to 450 mm and the weight 7 to 10 kg. The Indian civet is the largest viverrid in the genus.

The skull is elongate with strong zygomatic arches, blunt but prominent postorbital processes and a marked post-orbital constriction. The auditory bullae are relatively small. The dental formula is usually: i. 3/3; c. 1/1; pm. 4/4; m. 2/2 = 40. Normally there are two molars in the upper and lower jaw on each side, but occasionally there are three (Allen 1938).

Large Indian civets inhabit heavy scrub jungles of the Terai, duns and the lower foothills. Generally nocturnal and solitary, they take refuge during the day in thick undergrowth, but wander about villages and farmed areas at night. They prey on small mammals and birds and are quite destructive to poultry. They also feed on snakes, frogs, insects, fruit, vegetable matter, and carrion. They breed in May and June

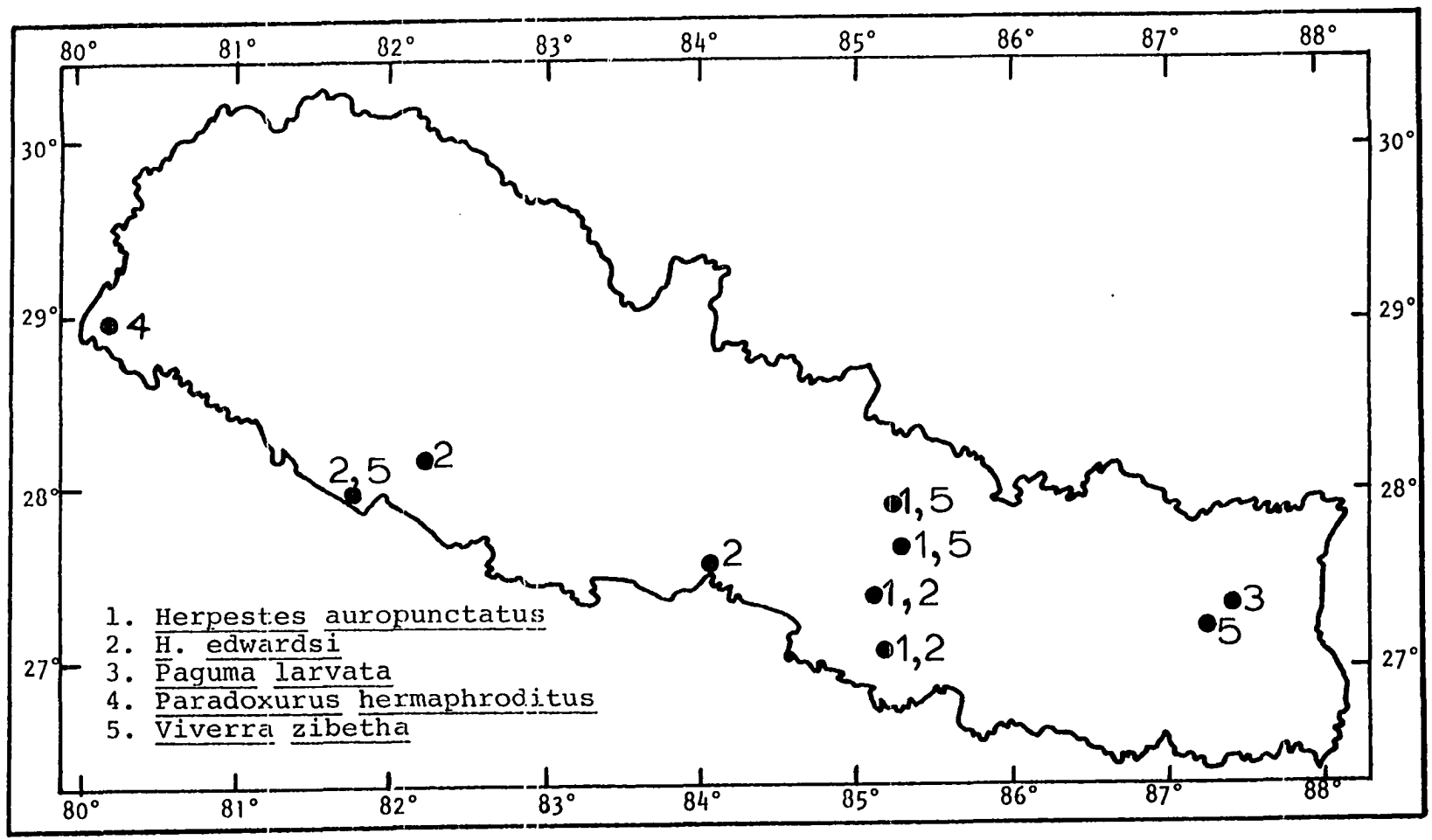


Fig. 60. Collection sites and sightings for family Viverridae

and the litter size is one to four. Young are born in burrows or in nests constructed in dense brush.

On 9 April, 1968, at Bahwanipur, Banke District, a pair of large Indian civets was seen chasing each other along a hedge row. At Mahadeva, Banke District, another was observed feeding on the carcass of a dead cow. In the Kathmandu Valley, one Indian civet was shot while feeding on a dead goat that had been killed by a leopard.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis C. f. orientis
Ixodoidea:	Haemaphysalis bispinosa H. indica H. sp.
Anoplura:	Parafelicola viverriculae

Prionodon pardicolor pardicolor Hodgson, 1842

Spotted Linsang

1842. Prionodon pardicolor Hodgson. Calcutta J. Nat. Hist. 2: 57.

Type locality: Nepal.

1844. Viverra perdicator Schinz. Syn. Mamm. 1: 366. (Error for pardicolor).

1846. Linsang pardicolor Gray. Cat. Hodgson's Coll. B. M. p. 8.

Type locality: Nepal.

1863. Prionodon pardochrous Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 4. (nom. nud.)

1925. Pardictis pardicolor presina Thomas. Proc. Zool. Soc. London. p. 499.

Type locality: Ngai Tio, Tonquin, Laos.

1933. Prionodon pardicolor pardicolor Hodgson, in Pocock. Proc. Zool. Soc. London. p. 972.

Distribution: Nepal, Sikkim, Assam, Upper Burma, Yunnan, Laos.

Nepal Records: Hodgson (1842d, p. 57), Gray (1846, p. 8; 1863b, p. 4), Hinton and Fry (1923, p. 411).

Habitat: Dense temperate forests from 600 to 4000 m (Pocock 1939).

Discussion: The Linsang is extremely slender with a long head and neck. The limbs are short and the tail is very long and cylindrical. The rounded ears are short and the muzzle pointed. The claws are sharp and retractile. Dorsally the color is fulvous or very pale brown with large black spots; the underparts are creamy or whitish. The black spots on the upper parts are arranged in more or less longitudinal rows, and the tail has eight to ten dark rings. Females have four pairs of mammae, two pectoral and two inguinal. Anal glands are also present. The length of the head and body is 370 to 430 mm, the length of the tail 300 to 350 mm and the weight less than 1 kg.

Linsangs are quite rare and inhabit the dense temperate forests of the eastern Himalayas. Their habits and

biology are not well-known. They are good climbers, active mainly at night. They feed chiefly on small birds, but also prey on small mammals and insects. According to Blanford (1891), they have two litters of two or three young each year. They are said to breed from February through August.

Hodgson (1842d) recorded the type locality of the spotted linsang as the central and northern hilly regions of Nepal, but no specimens have been collected from the area since. During six years of intensive investigations by the NEP, no skins or specimens of the linsang were encountered. Hodgson may have erred in his type locality since P. pardicolor is common in the tropical forests of the eastern Himalayas (Sikkim, Assam and Burma).

Paradoxurus hermaphroditus bondar (Desmarest, 1820)

Palm Civet or Toddy Cat

1820. Viverra bondar Desmarest. Mamm. p. 210.

Type locality: Bengal.

1832. Paradoxurus pennantii Gray. Proc. Zool. Soc. London. p. 66.

Type locality: Higher Province of Bengal.

1832. Paradoxurus crossi Gray. Proc. Zool. Soc. London. p. 67.

Type locality: India.

1836. Paradoxurus hirsutus Hodgson. Asiat. Res. 19: 72.

Type locality: Nepal Terai.

1846. Paradoxurus bondar Gray. Cat. Hodgson's Coll. B. M. p. 10.

Type locality: Nepal Terai.

1855. Paradoxurus strictus Horsfield (Hodgson MS). Ann. Mag. Nat. Hist. 16: 105.

Type locality: Nepal Terai.

1934. Paradoxurus hermaphroditus bondar (Desmarest), in Pocock. J. Bombay Nat. Hist. Soc. 37(1): 182.

Habitat: Kumaon, Nepal Terai, Bihar, north of the Ganges, Darjeeling, West Bengal.

Paradoxurus hermaphroditus pallasi Gray, 1832

1832. Paradoxurus pallasii Gray. Proc. Zool. Soc. London. p. 67.

Type locality: India.

1820. Viverra prehensilis Desmarest. Mamm. p. 208. (not of Kerr, 1792).

Type locality: Bengal.

1855. Paradoxurus quadriscriptus Horsfield (Hodgson MS). Ann. Mag. Nat. Hist. 16: 106.

Type locality: Nepal (Hills).

1864. Paradoxurus nigrifrons Gray. Proc. Zool. Soc. London. p. 535.

Type locality: India.

1910. Paradoxurus vicinus Schwarz. Ann. Mag. Nat. Hist. 6: 230.

Type locality: probably Assam.

1934. Paradoxurus hermaphroditus pallasii Gray, in Pocock. J. Bombay Nat. Hist. Soc. 37(1): 187.

Distribution: Nepal, Sikkim, Assam, Upper Burma.

Nepal Records: Hodgson (1836b, p. 72), Gray (1846, p. 10; 1863b, p. 5), Horsfield (1855, p. 105), Hinton and Fry (1923, p. 412).

NEP: 1 specimen: Mitchell - 1.

Habitat: Tropical and subtropical deciduous forests of the Terai, duns and lower foothills of the Siwalik and Mahabharat Ranges; 90 to 1500 m.

Taxonomic Notes: No two authors agree on the synonymy of P. h. bondar and P. h. pallasi. Some authors (Blanford 1891 and Gray 1846; 1863b) have placed these two subspecies into a single species. The criteria used to separate them (Gray 1832; 1864 and Pocock 1939) are the differences in the length of the pelage and in color. Their combined range is continuous throughout the lowlands of the Himalayas and they overlap in the Nepal Terai.

Field Notes: The palm civet is a medium-sized viverrid with long, coarse fur. The long, cylindrical tail is slightly shorter than the head and body length and is not prehensile, although it is capable of being slightly coiled. The soles of the feet are naked and the claws are small, sharp and retractile. The prescrotal and anal glands discharge into a fold of skin (Pocock 1934). The overall color of the pelage is grayish to brownish, but often it is masked by the black tips of the guard hairs. There is a

definite pattern of dorsal stripes and lateral spots on the shoulders, sides and thighs. The belly is grayish buff without spots. The feet are blackish brown. There are three pairs of mammae.

The skull lacks the high, narrow occipital crest of that of the other members in the family. The auditory bullae are slightly inflated. The dental formula is: i. 3/3; c. 1/1; pm. 4/4; m. 2/2 = 40. The molars have blunt and rounded cusps (Blanford 1891).

Palm civets are nocturnal and are expert climbers, spending most of their time in trees. Blanford (1891) listed small mammals, birds, lizards, snakes, eggs, fruit and vegetables as the main foods in their diet. They live and breed in holes in trees. Litters of two to four young are born in all months and more than one litter a year is produced.

Since the palm civet is strictly nocturnal, few specimens were encountered. A female was shot near Sisaiya, Kanchanpur District.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis orientis
Ixodoidea:	Haemaphysalis bispinosa Rhipicephalus haemaphysaloides

Paguma larvata grayi (Bennett, 1835)

Masked Palm Civet

1835. Paradoxurus grayi Bennett. Proc. Zool. Soc. London. 118.

Type locality: India.

1836. Paradoxurus nipalensis Hodgson. Asiat. Res. 19: 76.

Type locality: Nepal.

1846. Paguma grayii Gray. Cat. Hodgson's Coll. B. M. p. 9.

Type locality: Nepal.

1863. Paguma grayi Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 5.

Type locality: Nepal.

1934. Paguma larvata grayi (Bennett), in Pocock. J. Bombay Nat. Hist. Soc. 37(2): 330.

Range: Nepal, west to Kumaon.

Paguma larvata neglecta Pocock, 1934

1934. Paguma larvata neglecta Pocock. J. Bombay Nat. Hist. Soc. 37(2): 334.

Type locality: Mokochung, Naga Hills, Assam.

Range: Assam, west to Sikkim and the Nepal Terai, south to the Chin Hills and western Burma.

(Incertae sedis) Paguma lanigera (Hodgson, 1836)

1836. Paradoxurus lanigerus Hodgson. Asiat. Res. 19: 79.

Type locality: unknown.

1841. Paradoxurus laniger Hodgson. J. Asiat. Soc. Bengal 10: 909.

Type locality: northern region of Nepal.

1846. Paguma ? laniger Gray. Cat. Hodgson's Coll. B. M. p. 9.

Type locality: Nepal, northern hilly region.

1939. Paguma lanigera (Hodgson), in Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 416.

Distribution: The lower Himalayas from Kumaon to western Burma.

Nepal Records: Hodgson (1836b, pp. 76, 79; 1841e, p. 909), Gray (1846, p. 9; 1863b, p. 5), Hinton and Fry (1923, p. 412), Fry (1925, p. 527), Biswas and Khajuria (1957, p. 238).

NEP: 5 specimens: Mitchell - 4 (Darjeeling); AVWE - 1.

Habitat: Mixed broadleaf and temperate forests of the Siwaliks and Mahabharat Lekh, into the midlands, 600 to 2100 m.

Taxonomic Notes: Hodgson (1836b) based a new species of masked civet, Paguma lanigera, from the "northern region of Nepal" on the skin of an immature, without a skull. Pocock (1939) retained it as a valid species and gave the type locality as Tingree, Tibet. Ellerman and Morrison-Scott (1966) felt that since the skull was missing, its generic

position was not known. For example, Paguma differs from Paradoxurus chiefly in a single cranial character, the length of the palate. They therefore proposed to regard P. lanigera as incertae sedis.

Two forms of palm civets, P. l. grayi and P. l. neglecta are recognized from Nepal by Pocock (1939) and Ellerman and Morrison-Scott (1966). Pocock (1934) described neglecta from the Naga Hills of Assam, stating that it resembles the typical grayi of the hilly regions of Nepal. According to him, it differs from grayi in its noticeably shorter and less luxuriant winter coat, and generally the proximal portion of the tail is more brightly ochreous. Pocock (1934 , 1939) separated these two subspecies on the basis of color pattern alone. Since both of these forms are common to the low-lying regions of Nepal, it is possible that they are the same species.

Field Notes: The masked palm civet is distinguished from other Indian civets by its white whiskers and by the absence of any spots or stripes on its body. It is about the size of a house cat, with short limbs. There is generally a mask, which consists of a median white stripe, from the top of the head to the nose. A white line runs above and below each eye, extending to the base of the ear. The pelage is gray or gray tinged with buff, orange or yellowish red. The distal portion of the tail is darker gray than the basal

half. The feet are blackish. The number of mammae is four. The length of the head and body is 500 to 750 mm, the length of the tail 450 to 630 mm and the weight 3.5 to 5 kg.

The skull has a short, broad rostrum, and there is no deep constriction behind the postorbital processes. The number of teeth is the same as in Paradoxurus but they are more modified for crushing.

These viverrids inhabit temperate forests of the eastern Himalayas. Their habits are not well-known. They are nocturnal, arboreal and supposedly omnivorous. Blanford (1891) stated that they feed on small mammals, birds, fruit and vegetable matter. Small vertebrates, insects and roots have also been listed as part of the diet. They are reported to raise their young in tree hollows and to have litters of three to four. Allen (1938) reported collecting a female with two young, 8 to 10 days old, on 21 June.

Four specimens of this civet were collected from Darjeeling, West Bengal, India. They were shot, two each on successive nights, from a tung tree (Dipterocarpus turbinatus) while feeding on the fruit.

ECTOPARASITES

Ixodoidea: Haemaphysalis bispinosa
Ixodes lindbergi (="ovatus")
Rhipicephalus haemaphysaloides

Herpestes auropunctatus auropunctatus (Hodgson, 1836)

Small Indian Mongoose

1836. Mangusta auropunctata Hodgson. J. Asiat. Soc. Bengal 5: 235.

Type locality: Nepal.

1837. Herpestes nepalensis Gray. Charlesworth Mag. Nat. Hist. 1: 578.

Type locality: northern India.

1863. Herpestes nipalensis Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 5.

Type locality: Central Nepal.

1891. Herpestes auropunctatus Blanford. The Fauna Brit. India, Mamm. p. 121.

1918. Mungos auropunctatus Wroughton. J. Bombay Nat. Hist. Soc. 26(1): 56.

Type locality: Nepal.

1918. Mungos nipalensis Wroughton. J. Bombay Nat. Hist. Soc. 26(1): 56.

Type locality: North India.

1937. Herpestes javanicus auropunctatus Pocock. J. Bombay Nat. Hist. Soc. 39(2): 241.

Type locality: Nepal.

Distribution: Northern India, Kashmir, Nepal to Bhutan, Assam.

Nepal Records: Hodgson (1836c, p. 235), Gray (1846, p. 5), Wroughton (1918, p. 56), Hinton and Fry (1923, p. 412), Fry (1925, p. 527), Pocock (1937, p. 241).

NEP: 15 specimens: Maser - 15.

Habitat: Scrub jungle, hedgerows and cultivated fields in the Terai, duns, Siwaliks and larger valleys of the Mahabharats from 90 to 2100 m.

Field Notes: The small Indian mongoose is long and slender, the limbs are short, and the muzzle is pointed. The rounded ears are very short. The fur is long and coarse and is uniform olive-brown in color, flecked with golden yellow dorsally. Ventrally it is paler and somewhat yellowish gray. The longer guard hairs are annulated with alternating rings of golden and black. There are usually three pairs of mammae. Anal glands are present. The head and body length is 250 to 325 mm, the tail length 225 to 260 mm and the weight .5 to .75 kg (Pocock 1916).

The skull is characterized by the short, blunt muzzle and the well-developed postorbital processes. The dental formula is: i. 3/3; c. 1/1; pm. 4/4; m. 2/2 = 40, and the teeth are sectorial.

These mongooses inhabit the open cultivated lands, living in hedgerows, thickets and burrows which they dig. Diurnal, they usually hunt alone, but sometimes in family groups. Because they have little fear of man, they are readily tamed as pets. They feed on rodents, snakes, scorpions, centipedes, insects, birds, eggs and vegetable matter. They breed throughout the year and up to three litters are produced annually. The gestation period is about

60 days and the average litter consists of two to four young.

Maser collected specimens from Hitaura, Trisuli Bazaar and the Kathmandu Valley. In the Terai this species shares the same habitat as the Indian gray mongoose, Herpestes edwardsi. Individuals of both species were seen occupying the same burrow complex.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis C. f. orientis Nosopsyllus punjabensis N. simla
Ixodoidea:	Haemaphysalis sp. Ixodes redikorzevi group
Mallophaga:	Felicola rohani

Herpestes edwardsi nyula (Hodgson, 1836)

Indian Gray Mongoose, Common Mongoose

1836. Mangusta (Herpestes) nyula Hodgson. J. Asiat. Soc. Bengal 5: 236.

Type locality: Nepal Terai.

1846. Herpestes nyula Gray. Cat. Hodgson's Coll. B. M. p. 8.

Type locality: Open Terai, Nepal.

1915. Mungos mungo ellioti Wroughton. J. Bombay Nat. Hist. Soc. 24(1): 52.

Type locality: Ganoor, Nimar, India.

1915. Mongos mungo moerens Wroughton. J. Bombay Nat. Hist. Soc. 24(1): 52.

Type locality: Ganoor, Nimar, India.

1921. Herpestes edwardsi ellioti Thomas and Wroughton. J. Bombay Nat. Hist. Soc. 27(4): 547.

1941. Herpestes edwardsi nyula (Hodgson), in Pocock. The Fauna Brit. India, Mamm. Vol. 1, p. 9.

Distribution: Northern India, Nepal Terai to Assam.

Nepal Records: Hodgson (1836c, p. 236), Gray (1846, p. 8), Hinton and Fry (1923, p. 412), Chesemore (1970, p. 164).

NEP: 10 specimens: Maser - 5; Mitchell - 5.

Habitat: Scrub jungle and farm lands of the Terai and duns from 90 to 1000 m.

Field Notes: The common mongoose is much larger than H. auropunctatus. The color is tawny yellowish gray, with alternate light and dark rings on the hairs giving the coat a grizzled "salt and pepper" tinge. There is a ferruginous tinge on the head and feet and the tail is rufous gray, tipped with yellowish red. Three pairs of mammae are present. The average weight is about 1.5 kg (Pocock 1916).

Common mongooses are found in and around villages of the Terai and duns. They live in burrows which they dig; once three H. edwardsi and one H. auropunctatus were chased into the same burrow complex.

The diet is varied, principally rodents, snakes, lizards, birds, eggs and insects. The stomach contents of an individual included a rat, insects and vegetable matter. Diurnal, they may be seen foraging about in hedgerows, thickets

and clumps of grass at all hours of the day. Prater (1965) gave the breeding season as year round with three litters produced annually. The gestation period is approximately 60 days and the number of young produced is three to four. In April of 1968, two pregnant females, each carrying two embryos, were collected at Bahwanipur, Banke District.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis C. f. orientis Nosopsyllus punjabensis
Ixodoidea:	Amblyomma sp. Dermacentor auratus Haemaphysalis bispinosa H. howletti H. indica H. montgomeryi H. sp. Rhipicephalus haemaphysaloides
Parasitoidea:	Laelaps nuttalli
Mallophaga:	Felicola rohani

Herpestes urva (Hodgson, 1836)

Crab-eating Mongoose

1836. Gulo urva Hodgson. J. Asiat. Soc. Bengal 5: 238.

Type locality: Nepal.

1837. Urva cancrivora Hodgson. J. Asiat. Soc. Bengal 6: 561-64.

Type locality: Nepal.

1841. Mesobema cancrivora Hodgson. J. Asiat. Soc. Bengal 10: 910.

Type locality: Nepal.

1891. Herpestes urva (Hodgson), in Blanford. The Fauna Brit. India, Mamm. p. 129.

1907. Urva hanensis Matschie. Wiss. Ergebn. Exped. Filchner to China 10(1): 190.

Type locality: Hankow, China.

1936. Herpestes urva annamensis Bechthold. Zeit. Säuget. 11: 150.

Type locality: Phu Qui, Annam, Indo-China.

1936. Herpestes urva formosanus Bechthold. Zeit. Säuget. 11: 151.

Type locality: Formosa.

1936. Herpestes urva sinensis Bechthold. Zeit. Säuget. 11: 152.

Type locality: Kwantung, southern China.

Distribution: Nepal, Assam, Burma to southern China, Indo-China, Formosa, Hainan.

Nepal Records: Hodgson (1836c, p. 328; 1837b, p. 561; 1841e, p. 910), Gray(1846, p. 8), Fry (1925, p. 527).

Habitat: Valleys of the lower and central regions of Nepal (Jerdon 1867), along streams in the Himalayas and Burma (Blanford 1891).

Discussion: The crab-eating mongoose is considerably larger than H. edwardsi with a comparatively short tail, not more than two-thirds the length of the head and body. The uniform coarsely grizzled pelt is black and buffy white. The

feet are dusky brown with the soles of the hind feet hairy nearly to the hallux. A conspicuous white stripe runs from the corner of the mouth to the shoulder (Allen 1938; Pocock 1941). The head and body length is 450 to 500 mm, the tail length 250 to 300 mm, and the weight 1.5 to 2.5 kg. The skull is proportionally less elongate than H. edwardsi and differs notably in the shape of the auditory bullae (Allen 1938).

Crab-eating mongooses are somewhat aquatic and live chiefly on frogs and crabs. Prater (1965) recorded this species as preying on mouse-deer, hares, bandicoot rats, birds and reptiles. Like other members of the genus, they live in burrows. Little is known about the breeding habits; litters of two to three young have been reported (Blanford 1891).

Fry (1925) reported the last collection of crab-eating mongooses from Nepal. Allen (1938) stated that they were commonly seen among the terraced rice fields in the mountainous regions of southern China. Many empty crab shells were found along small irrigation ditches and rice paddies in the Kathmandu Valley. Possibly these crabs were eaten by H. urva, but the species has never been reported from the area.

Hyaena hyaena hyaena (Linnaeus, 1758)

Striped Hyaena

1758. *Canis hyaena* Linnaeus. Syst. Nat. 10th ed. Vol. 1, p. 40.

Type locality: Benna Mountains, Laristan, southern Persia.

1777. *Hyaena striata* Zimmermann. Spec. Zool. Geogr. p. 366. (renaming of *hyaena* Linnaeus).

1780. *Hyena striata* Zimmermann. Geogr. Gesch. 2: 256.

Type locality: Benna Mountains, Laristan, southern Persia.

1808. *Hyaena orientalis* Tiedemann. Zool. p. 350. (renaming of *hyaena* Linnaeus).

1820. *Hyaena fasciata* Thunberg. Sv. Vet. Akad. Handl. 1: 59. (renaming of *hyaena* Linnaeus).

1820. *Hyena antiquorum* Temminck. Ann. Gen. Sci. Phys. 3: 51 (renaming or *hyaena* Linnaeus).

1840. *Hyaena virgata* Ogilby, *in* Royle. Illustr. Bot. Himalaya LXVI. (renaming of *hyaena* Linnaeus).

1844. *Hyaena vulgaris indica* Blainville. Osteogr. Mamm. 2, Hyènes, p. 82 and expl. of pl. 6.

Type locality: India.

1905. *Hyaena vulgaris zarudnyi* Satunin. Mitt. Kauk. Mus. 2: 14, 19.

Type locality: Karun River, southwestern Persia.

1910. *Hyaena* (*Hyaena*) *vulgaris satunini* Matschie. S. B. Ges. Nat. Fr. Berlin. p. 363.

Type locality: Transcaucasia.

1941. *Hyaena hyaena hyaena* (Linnaeus), *in* Pocock. The Fauna Brit. India, Mamm. Vol. 2, p. 68.

Distribution: Southern Persia to Baluchistan,

Afghanistan, throughout peninsular India, Nepal Terai.

NEP: 2 sightings: Mitchell - 2.

Habitat: Open plains and scrub jungle of the western Terai.

Field Notes: Hyaenas are heavy and ungainly with a deep, massive chest and slender hind quarters. The head is large and slightly elongated with large, pointed ears. The limbs are long and sturdy. The front and hind feet have four toes each. The hallux and pollex are lacking, and the tarsus and metatarsus are completely hairy. These animals possess a large glandular pouch below the tail which nearly obscures the external genitalia. The hair is rather coarse and they have an erectile mane of long hairs (up to 300 mm) along the neck and back. The striped hyaenas are grayish to light yellowish brown in color with dark brown to black markings across the neck and around the legs. The lower legs and feet are almost black. The length of the head and body is 900 to 1200 mm, the length of the tail about 300 mm, and the body weight 27 to 54 kg (Walker et al. 1964b).

The skull has a well-developed sagittal crest and the zygomatic arches are very strong. The auditory bullae are inflated. The teeth are well-developed with the upper sectorial teeth very large. The dental formula is: i. 3/3; c. 1/1; pm. 4/3; m. 3/3 = 42.

Hyaenas are found in the drier regions of the western

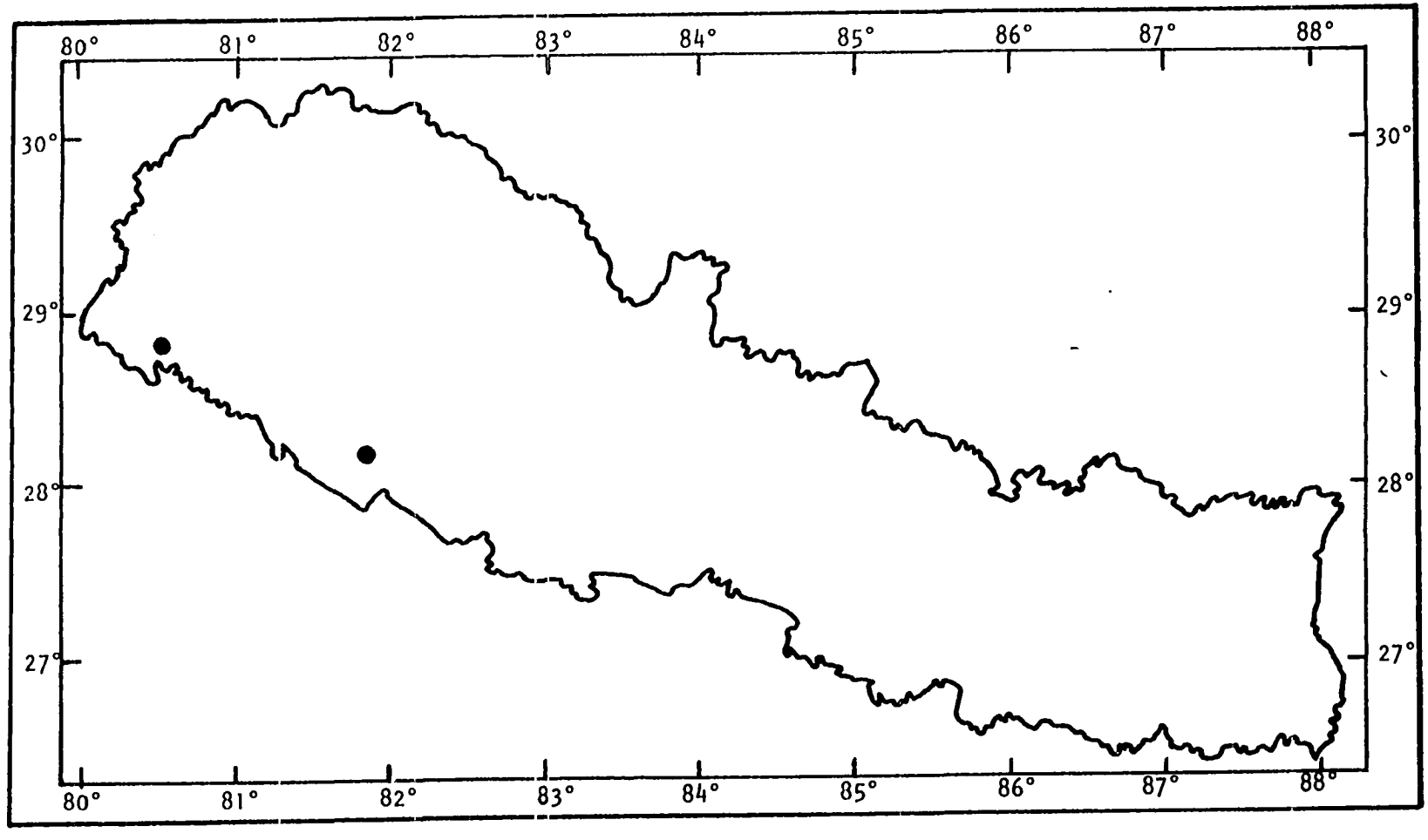


Fig. 61. Sightings for Hyaena hyaena

Terai and their chief haunts are rocky hills and deep ravines. They are nocturnal, spending the day in caves, rocks or dens. As scavengers, their principal food is carrion, but sometimes they kill goats and other small animals. The gestation period is approximately three months and the number of young in a litter is two to six.

There are no previous records of the striped hyaena from Nepal. Pocock (1941) listed a single specimen collected by Hodgson from the Nepal Terai, but Gray (1863b) recorded the collection site of this specimen as the Sikkim Terai. On 18 March, 1970, the howl of a hyaena was heard near Mahadeva and on 20 March a hyaena was sighted crossing in front of the jeep lights. Another was seen near Dhangarhi, Kailali District.

Felis chaus affinis Gray, 1830

Jungle Cat

1830. Felis affinis Gray. Illustr. Ind. Zool. 1: pl. 3.

Type locality: Gangootri in Tehri Garhwal, northern India.

1836. Lynchus erythrotus Hodgson. J. Asiat. Soc. Bengal 5: 233.

Type locality: Nepal.

1844. Felis jacquemontii Geoffroy. Jacquemont's Voy. 4: 58, Atlas 2, pl. 2 and 3.

Type locality: Kursali, near Dehra Dun, northern India.

1846. Chaus libycus Gray. Cat. Hodgson's Coll. B. M. p. 7.
Type locality: Nepal Terai.

1867. Felis chaus Jerdon. The Mamm. of India. p. 111.

1898. Felis chaus affinis Gray, in de Winton. Ann. Mag. Nat. Hist. Ser. 7, 2: 291.

Distribution: The Himalayas from Kashmir to Sikkim.

Nepal Records: Hodgson (1836c, p. 233), Gray (1846, p. 7), Hinton and Fry (1923, p. 422), Fry (1925, p. 527), Biswas and Khajuria (1957, p. 238), Chesemore (1970, p. 165).

NEP: 16 specimens: Mitchell - 13; Maser - 2; AVWE - 1.

Habitat: The scrub jungle and cultivated areas of the Terai, extends into the midlands; 90 to 2700 m.

Field Notes: The jungle cat is slightly larger than the house cat and lacks any dark markings such as spots or stripes. The legs are long and the tail is comparatively short. The fur varies from sandy gray to yellowish gray. The tail is ringed with black and has a black tip. The paws are pale yellowish brown and the ears are reddish and tipped with a small pencil of black hairs. The skull has a short rostrum, long postorbital processes and a broad ascending maxillary process.

Jungle cats inhabit a number of different biotopes from the dense Terai jungles (100 m) to the oak-rhododendron forests of the midlands (2700 m). They are frequently encountered in the Terai and duns, where they prefer the more

open parts of the jungle: grasslands, scrub and stream banks. Both diurnal and nocturnal, they are most active in the early morning and the late evening. They prey on small mammals, birds and poultry. A jungle cat once seized a pair of chickens from our compound in Kathmandu.

Field information indicates that females have litters of three to four young from November to December and from April to May. Two females taken in December were lactating. Another female collected in April bore three embryos averaging 155 mm in length. Two immatures measuring less than 550 mm in total length were collected in March.

Jungle cats responded readily to a predator call and many times approached within 10 m of our blind. They showed little fear, walking straight towards the blind -- not circling like a fox. When within 5 to 10 m of the blind, they would lie down and wait up to 15 minutes without showing any signs of concern.

ECTOPARASITES

Siphonaptera:	Ctenocephalides felis felis
	C. f. orientis
	Xenopsylla astia
	X. cheopis
Ixodoidea:	Amblyomma sp.
	Dermacentor auratus
	Haemaphysalis bispinosa
	H. howletti
	H. indica
	H. sp.
	Hyalomma sp.

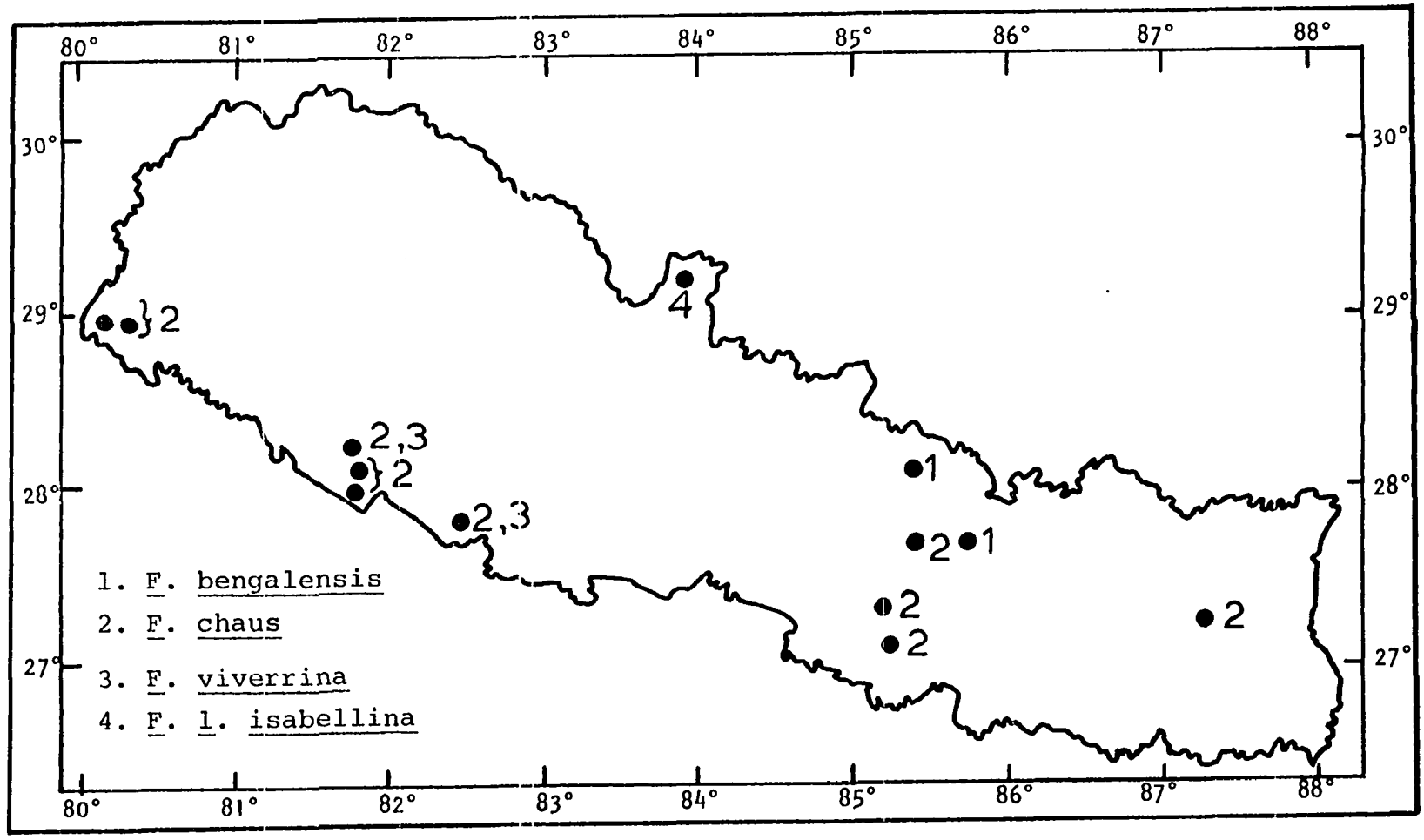


Fig. 62. Collection sites for Felis sp.

Rhipicephalus haemaphysaloides

Mallophaga: Actornithophilus hoplopteri

Felis lynx isabellina Blyth, 1847

Tibetan Lynx

1847. Felis isabellina Blyth. J. Asiat. Soc. Bengal 16: 1178.

Type locality: Tibet.

1846. Lyncus vulgaris Gray. Cat. Hodgson's Coll. B. M. p. 7. (nom. nud.)

Type locality: Tibet.

1863. Lyncus tibetanus Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 4.

1867. Lyncus isabellinus Gray. Proc. Zool. Soc. London. p. 276.

Type locality: Tibet.

1891. Felis lynx Blanford. The Fauna Brit. India, Mamm. p. 89.

1938. Lynx lynx isabellina Allen. The Mamm. of China and Mongolia. Vol. 11 (part I), p. 489.

Type locality: Tibet.

1939. Lynx lynx isabellinus Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 311.

Type locality: Tibet.

1966. Felis lynx isabellina Blyth, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 309.

Type locality: Tibet.

Distribution: Gilgit, Kashmir, Tibet, Mustang District,

Nepal, north to Tianshan and Altai Mountains.

NEP: 1 skin: Mitchell - 1.

Habitat: Juniper thickets and rocky ravines of the Mustang District, 2800 to 4300 m.

Discussion: The lynxes, as Pocock (1917b & c) has shown, are closely related to the other smaller cats of the genus Felis. They are given generic rank in the subfamily Felinae by him. Allen (1938) felt that the body and skull characters were distinct enough from other members of Felis to separate these cats into their own genus, Lynx. Ellerman and Morrison-Scott (1966) have treated the lynx as a subgenus of Felis.

These cats have relatively short bodies, long, heavy limbs, furred feet and prominent ear tufts. The males have a well-marked ruff at the sides of the throat. The fur is rather long and soft. The color is frosted red above and white beneath, with a few black spots on the insides of the forelimbs and the sides of the belly. The flanks and outer sides of the legs have indistinct reddish spots. The feet are pale sandy and the tail is tipped black. The head and body length is 850 to 950 mm, the tail length 180 to 230 mm and the weight 10 to 15 kg. Prater (1965) reported males weighing up to 27 kg.

In the skull, the rostrum is short and the ascending branch of the maxillary is narrow, tapering backward. The dental formula differs from that of Felis by the loss of the

first upper premolar.

Lynxes inhabit the arid alpine region of Mustang. Secretive in habits, they usually hunt alone, preying on woolly hares, pikas, rodents and ground birds. According to Walker et al. (1964b), mating takes place in late winter and after a gestation period of about 60 days, one to four kittens are born.

A lynx skin was purchased in Mustang Village, Mustang District. A local hunter was said to have collected the specimen from the nearby hills. Since the Tibetan border lies 10 to 15 km north of Mustang, the skin could have been brought from Tibet, where this species is more plentiful. Lynx fur is often used for garment trimmings by the locals.

Felis marmorata charltoni Gray, 1846

Himalayan Marbled Cat

1846. Felis charltonii Gray. Ann. Mag. Nat. Hist. 18: 211.
Type locality: Darjeeling, West Bengal, India.

1847. Felis ogilbii Hodgson. J. Nat. Hist. Calcutta 8: 44.
Type locality: Sikkim.

1863. Leopardus dosul Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 3. (nom. nud.)

1863. Felis duvaucelli Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 3. (nom. nud.)

1867. Catolynx charltoni Gray. Proc. Zool. Soc. London. p. 268.

Type locality: Darjeeling.

1891. Felis marmorata Blanford. The Fauna Brit. India, Mamm. p. 74.

1932. Pardofelis marmorata charltoni Pocock. Proc. Zool. Soc. London. p. 746.

Type locality: Darjeeling.

1966. Felis marmorata charltoni Gray, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 311.

Distribution: The eastern Himalayas, Darjeeling, Sikkim, Assam, Burma, possibly Nepal.

Habitat: Tropical and subtropical forests of the hilly regions of the eastern Himalayas, from 500 to 3000 m.

Discussion: The marbled cat is larger than a domestic cat. The bushy tail is about three-quarters the length of the head and body. The ears are short and rounded. The fur is soft and thick, with the color varying from brownish gray to rufous brown and the underparts lighter. The pattern of the coat consists of stripes on the head, neck and back with large and small blotches or marbling on the flanks. There are black spots on the outer portion of the limbs, the upper surface of the tail and the underparts of the body. The head and body length is 475 to 585 mm and the tail length 360 to 400 mm.

The skull is short and robust with wide zygomatic arches. The posterior edge of the bony palate is deeply concave. The teeth, especially the canines, are stout and

well-developed.

Arboreal and strictly nocturnal, this rare feline inhabits tropical and subtropical forests of the eastern Himalayas. Its diet consists of squirrels, rats and birds. Little is known about its reproductive biology.

Several authors (Horsfield 1855; Pocock 1939; Prater 1965) have reported the range of the marbled cat as extending into Nepal, but none have been collected from the country. Very few specimens have been collected elsewhere. Since it has been taken in Darjeeling, it may possibly occur in the northeastern districts of Nepal.

Felis temmincki temmincki Vigors & Horsfield, 1827

Golden Cat

1827. Felis temminckii Vigors and Horsfield. Zool. J. 3: 451.

Type locality: Sumatra.

1831. Felis moormensis Hodgson. Gleanings in Science 3: 177.

Type locality: Nepal.

1846. Leopardus moormensis Gray. Cat. Hodgson's Coll. B. M. p. 5.

Type locality: Central hilly region, Nepal.

1863. Felis aurata Blyth. Proc. Zool. Soc. London. p. 185.

Type locality: Southeast Himalayas.

1863. Felis nigrescens Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 4.

Type locality: Darjeeling.

1924. Felis temminckii bainsei Sowerby. J. Sci. and Arts, China 2: 352.

Type locality: Tengueh, southwestern Yunnan, China.

1932. Profelis temminckii temminckii Pocock. Proc. Zool. Soc. London. p. 748.

Type locality: Sumatra.

1966. Felis temmincki temmincki Vigors and Horsfield, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 312.

Distribution: The eastern Himalayas: Nepal, Darjeeling, Sikkim, Assam, Burma to Yunnan; China, Indo-China, Malay Peninsula, Sumatra.

Nepal Records: Hodgson (1831b, p. 177; 1832b, p. 10), Gray (1846, p. 5).

Habitat: Central hilly regions at moderate elevations (Gray 1846).

Discussion: The golden cat is the largest of the smaller Oriental felines and is placed in a separate subgenus (Profelis) (Allen 1938; Ellerman and Morrison-Scott 1966). The body is long and slender, the tail long and cylindrical. The coloration varies from golden brown or dark brown to a bright ferruginous. Usually the head, neck and back are bright ferruginous with the sides of the neck and body paler, nearly cinnamon. The feet are gray. Characteristic facial markings in the form of white and blackish stripes are present. The head and body length is 700 to

800 mm with the tail length 425 to 475 mm.

In the skull, the postorbital processes are relatively short, the nasals are broad and there is a well-developed sagittal crest. The first small upper premolar is often lacking.

This secretive cat is confined to the temperate forests of the eastern Himalayas. It is said to prey on poultry, goats, sheep and small deer (Prater 1965). Supposedly, litters of two or three young are raised in hollow trees (Blanford 1891).

Collections of this species are few. Blanford (1891) stated that the golden cat is rare in Nepal and a single skull collected by Hodgson (Gray 1846) is the only record from the country.

Felis bengalensis horsfieldi (Gray, 1842)

Leopard Cat

1832. Felis nipalensis Hodgson. J. Asiat. Soc. Bengal 1: 341.

Type locality: Nepal.

1842. Leopardus horsfieldii Gray. Ann. Mag. Nat. Hist. 10: 260.

Type locality: Bhutan.

1844. Felis pardochrous Hodgson. J. Nat. Hist. Calcutta 4: 286.

Type locality: Nepal.

1939. Prionailurus bengalensis horsfieldi Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 271.

Type locality: Bhutan.

1966. Felis bengalensis horsfieldi (Gray), in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 313.

Distribution: Kumaon, Nepal, Darjeeling, Sikkim, Bhutan.

Nepal Records: Hodgson (1832a, p. 341), Hinton and Fry (1923, p. 10), Biswas and Khajuria (1957, p. 238).

NEP: 3 specimens: Maser - 2; Mitchell - 1.

Habitat: Dense, deciduous broadleaf forests of the Mahabharats and oak-rhododendron forests of the midlands, from 900 to 2600 m.

Taxonomic Notes: Hodgson (1832a) identified and described the leopard cat as Felis nipalensis, but the name had been previously used. Gray (1842) discovered the mistake and proposed Leopardus horsfieldi as the name of the leopard cat. Later, Pocock (1941) placed the leopard cat in a separate genus of its own, Prionailurus, contending that the skull differs from that of Felis in a number of characters. Ellerman and Morrison-Scott (1966) reduced Prionailurus to a subgeneric position and reinstated Felis as the genus for the leopard cat.

Field Notes: The leopard cat is about the size of a domestic cat, but the legs are longer. The tail is usually

less than half the head and body length. The dorsal pelage is pale fulvous, varying from rufous to gray; the underparts are whitish. There is a pattern of more or less elongate black spots on the body with about five longitudinal rows of these spots on the sides. Above and below the eye, there are two narrow black stripes that run to the corner of the jaw. There are three or four blackish brown marks on the lower throat. The head and body length is 550 to 650 mm, the length of the tail 250 to 300 mm and the weight 3 to 4 kg.

The skull has long, narrow postorbital processes, nearly vertical ascending maxillary processes and downward curving frontals and nasals.

These cats are secretive, inhabiting dense deciduous forests of the Mahabharat range. They are nocturnal and usually hunt alone, seeking shelter in caves, ravines and hollow trees. Their diet consists of small mammals, ground birds and possibly poultry.

Allen (1938) reported collecting a number of kittens during May from northern China. Most likely, there is one litter a year with one to four kittens born in spring (March through May). According to Prater (1965) young are born in India during May. It has been reported that leopard cats will interbreed with domestic cats (Blanford 1891).

Maser collected two specimens from the oak-rhododendron forests of the central midlands while I took one from

Phulchoki Danda, the Kathmandu Valley.

ECTOPARASITES

Siphonaptera: *Ctenocephalides felis felis*
Paraceras sauteri
Pulex irritans

Ixodoidea: *Ixodes acutitarsus*
I. tanuki

Felis viverrina viverrina Bennett, 1833

Fishing Cat

1833. *Felis viverrinus* Bennett. Proc. Zool. Soc. London. p. 68.

Type locality: India.

1834. *Felis himalayanus* Jardine. Nat. Libr. Felinae 4: 230. pl. 24.

Type locality: Himalayas.

1836. *Felis viverriceps* Hodgson. J. Asiat. Soc. Bengal 5: 232.

Type locality: Nepal.

1846. *Leopardus celidogaster* Gray. Cat. Hodgson's Coll. B. M. p. 6.

Type locality: Nepal Terai.

1863. *Felis viverrina* Bennett, *in* Blyth. Proc. Zool. Soc. London. p. 184.

1867. *Viverriceps bennettii* Gray. Proc. Zool. Soc. London. p. 268.

Type locality: India.

1939. *Prionailurus viverrinus* Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 281.

Distribution: India, from the Indo-Gangetic Plain to the base of the Himalayas, the Nepal Terai to Burma.

Nepal Records: Hodgson (1836c, p. 232), Gray (1846, p. 6), Hinton and Fry (1923, p. 410).

NEP: 2 specimens: Mitchell - 2.

Habitat: Along streams and swamps in jungles of the Terai and duns, from 90 to 800 m.

Field Notes. The fishing cat has a stout body and short limbs. It is distinguished from the leopard cat by the larger size and shorter tail. The pelage is earthy gray with a brownish tinge. Six to eight black lines run from the forehead to the nape, breaking up into shorter lines and spots on the shoulders and continuing as rows of spots down the back. The flanks are spotted and the belly is white.

The skull is long and the occipital and sagittal crests are well-developed. The nasals are long and broad and the teeth are large.

This nocturnal species inhabits marshy thickets along rivers and near swamps. The popular name, fishing cat, reflects testimony that this felid feeds on fish and fresh-water mollusks. Prater (1965) described its method of fishing, but stated that it never enters water in pursuit of prey. A female fishing cat was shot while she was wading in a marsh and a second female was taken while feeding on a buffalo carcass. The dietary habits indicate that it is

more carnivorous than piscivorous; its food consists of fresh water invertebrates, small mammals, birds and carrion. Prater (1965) reported that it attacks and kills livestock and poultry. Litters of one to four young are usually born in May.

ECTOPARASITES

Siphonaptera:	Acropsylla episema
	Nosopsyllus punjabensis
Ixodoidea:	Dermacentor auratus
	Haemaphysalis bispinosa
	H. canestrinii
	H. sp.
	Rhipicephalus haemaphysaloides
Diptera:	Lipoptena axis

Neofelis nebulosa macrosceloides (Hodgson, 1853)

Clouded Leopard

1843. Felis macrocelis Tickell. J. Asiat. Soc. Bengal 12: 814. (Not of Temminck, 1824).

1846. Leopardus macrosceloides Gray. Cat. Hodgson's Coll. B. M. p. 3. (nom. nud.)

Type locality: Sikkim.

1853. Felis macrosceloides Hodgson. Proc. Zool. Soc. London. p. 192, pl. 38.

Type locality: Nepal.

1867. Neofelis macrocelis Gray. Proc. Zool. Soc. London. p. 266.

Type locality: Himalayas.

1891. Felis nebulosa Blanford. The Fauna Brit. India, Mamm. p. 72.

1939. Neofelis nebulosa macrosceloides (Hodgson) in Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 250.

Distribution: Nepal to Burma.

Nepal Records: Hodgson (1841e, p. 908), Gray (1846, p. 3), Hinton and Fry (1923, p. 410).

Habitat: In dense temperate forests of the midlands, 1500 to 2200 m.

Discussion: The clouded leopard has a long body and tail and short limbs. The dorsal pelage varies from gray or earthy brown to pale or yellowish brown. The underparts are white or pale tawny. Cheek stripes are present and the head is spotted. Two broad bands, with narrower bands of elongate spots between them, run from between the ears to the shoulders. Large oval or elongate blotches are found on the back and flanks. The limbs and underparts are spotted. The long tail is dark ringed and the short ears are black. The length of the head and body is 600 to 1000 mm, the length of the tail 600 to 900 mm and the weight usually 16 to 25 kg.

The skull has short, widely separated postorbital processes. The lower edge of the orbit is distinctly thickened and the nasals are broad. The canine teeth are exceptionally long.

Clouded leopards inhabit dense temperate forests of the middle Himalayas. Prater (1965) suggested that these

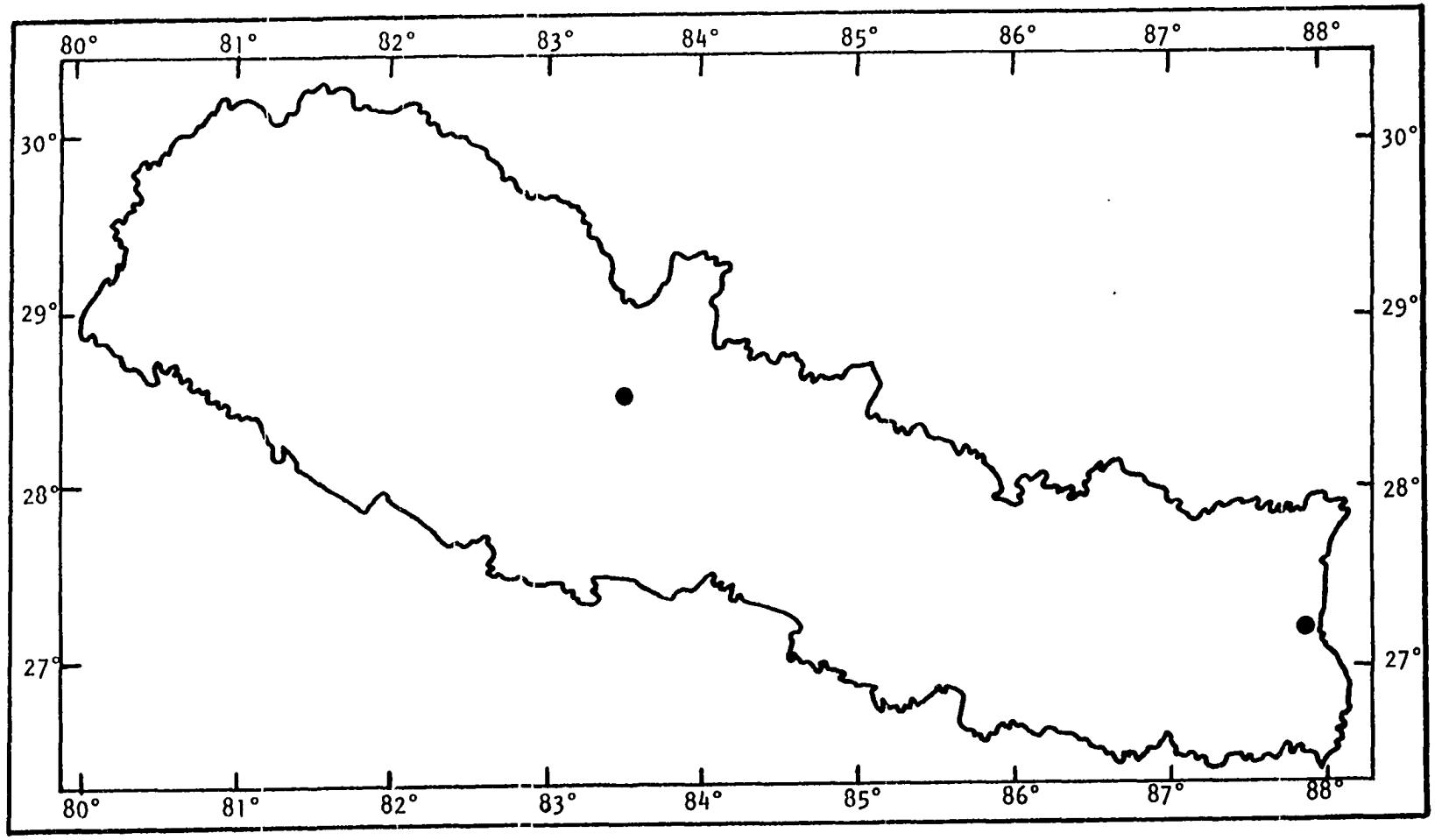


Fig. 63. Sightings for Neofelis nebulosa

leopards are largely arboreal and hunt by night. They feed on a variety of animals including monkeys, deer, birds and livestock. Young are born in hollow trees and the litter size is usually two (Blanford 1891).

Specimens are quite rare in collections. Of the numerous skins of large cats for sale at furriers in Calcutta, New Delhi and Kathmandu, only two were of clouded leopards. During our study, there were only two reports of this species from Nepal. I saw a skin for sale in a bazaar at Baglung, Baglung District; and in 1970 Fleming, Jr., in conversation, reported that a clouded leopard had killed a goat in the Ilam District.

Panthera pardus fusca (Meyer, 1794)

Indian Leopard or Panther

1794. Felis fusca Meyer. Zool. Ann. 1: 394.

Type locality: Bengal.

1846. Leopardus varius Gray. Cat. Hodgson's Coll. B. M. p. 5.

Type locality: Hilly regions, Nepal.

1856. Felis longicaudata Valenciennes. C. R. Acad. Sci. Paris 42: 1036.

Type locality: Ceylon and Malabar Coast.

1868. Panthera antiquorum Fitzinger. S. B. Akad. Wiss. Wien. 58: 466.

1870. Felis pardus Swinhoe. Proc. Zool. Soc. London. p. 628.

Type locality: Southern China.

1896. Felis pardus var. melas Pousargues. Bull. Mus. H. N. Paris 2(5): 181.

1904. Felis pardus chinensis Brass. Nutzbare Tiere Ostasiens. p. 6.

1912. Felis pardus variegata Allen. Mem. Mus. Comp. Zool. Harvard 40: 235.

Type locality: Changyanghsien, Hupeh, China.

1924. Felis pardus pardus Dollman, after Lydekker. Game Animals of India. p. 314.

Type locality: India.

1930. Panthera pardus fusca (Meyer), in Pocock. J. Bombay Nat. Hist. Soc. 34(2): 307.

1938. Felis pardus fusca Allen. Mamm. of China and Mongolia. Vol. 11 (Part I), p. 473.

Type locality: Bengal.

Range: Sri Lanka and peninsular India, Nepal.

Panthera pardus pernigra (Gray, 1863)

1863. Leopardus perniger Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 3, and Preface V.

Type locality: Sikkim.

1863. Felis pardus var. melania Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 3.

Type locality: Sikkim.

1939. Panthera pardus pernigra (Gray), in Pocock. Fauna Brit. India, Mamm. Vol. 1, p. 231.

Range: Sikkim, Nepal.

Distribution: Sri Lanka, Indian peninsula from Cape Comorin to the Himalayas, Kashmir, Nepal to southern China.

Nepal Records: Hodgson (1841a, p. 908), Gray (1846, p. 5; 1863b, p. 3), Hinton and Fry (1923, p. 410), Chesemore (1970, p. 165).

NEP: 2 specimens: Maser - 1; Mitchell - 1.

Habitat: The Terai and duns to moderate elevations in the midlands, 300 to 2500 m.

Taxonomic Notes: Pocock (1917c) separated the larger cats, in which the suspensorium of the hyoid apparatus is imperfectly ossified, from the smaller cats, in which that portion is bony, to form a separate subfamily, Pantherinae. In this group, he included two genera: Panthera for common leopards, jaguars, lions and tigers and Uncia for snow leopards.

Hodgson (in Gray, 1863b) proposed the name Leopardus perniger for a melanistic leopard collected from Sikkim. Pocock (1939) felt that the melanistic phase of the leopard is not applicable for a recognized race. He stated, "I overlooked the description in the preface and also Cabrera's reference to it when I wrote my paper on the Panthers of Asia in 1930, and on the account of Hodgson's specimens, I identified them as Panthera pardus, cited Nepal as their locality and quoted pernigra as a nomen nudum."

Leopards from different geographical regions vary

in size, color pattern and length of pelage. Many subspecies have been proposed on the above criteria but P. p. fusca is the only true form recognized for the Indian subcontinent.

Field Notes: In leopards, the pelage is usually short and the color fulvous or bright fulvous marked with black rosettes. The spots on the head are small and more or less rounded, while on the flanks, belly and outer sides of the legs, the markings become solid black blotches. The long tail is pale yellow with a double row of elongate black spots. The head and body length is 900 to 1500 mm and the tail length is 900 to 1200 mm. The weight is 40 to 70 kg, the average male being about 55 kg and the female 40 kg.

Leopards inhabit a number of different biotopes from subtropical jungles to coniferous forests. They take the path of least resistance, prowling stream beds, foot paths and jungle roads. Generally nocturnal, they usually hunt alone, but sometimes in pairs. A pair of leopards was sighted in the daytime near Gulari, Banke District. The call is between a grunt and a cough, repeated quickly four to five times.

Leopards will kill and feed on almost anything, but they have a predilection for dogs, monkeys and goats. At high altitudes during winter, leopards move close to villages, preying extensively on domestic animals. One killed 17 dogs and a house cat from the Ananda Ban Hospital compound,

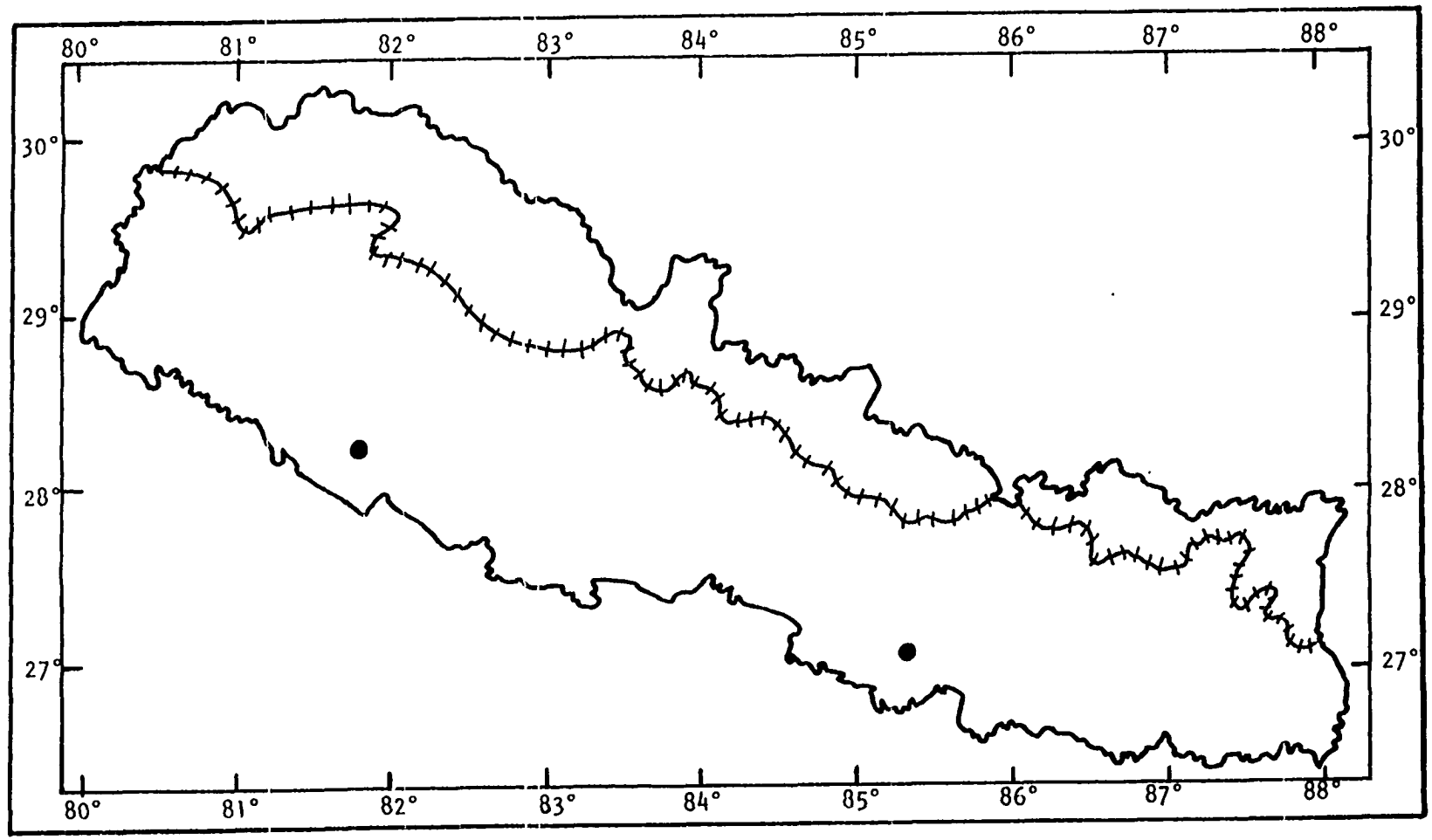


Fig. 64. Collection sites and estimated distribution for Panthera pardus

Lalitpur District. A leopard was once spotted feeding on a chital (Axis axis) fawn in the fork of a tree 15 m above the ground. Although this is the usual habit of the African leopard, it is the only case that I have seen or heard of concerning the Indian leopard. Leopards usually kill their prey by biting the animal through the base of the skull. They do not feed as neatly as tigers do on a kill. The entrails are generally eaten and remnants of the prey are scattered over a large area.

According to Prater (1965), leopards breed throughout the year. In Nepal, leopards mate in November and December; their mating calls were heard throughout these months. The gestation period is about 13 weeks and two to four young are born during February and March.

ECTOPARASITES

Ixodoidea: Dermacentor auratus
Haemaphysalis bispinosa
H. indica
H. spinigera

Panthera tigris tigris (Linnaeus, 1758)

Bengal Tiger

1758. Felis tigris Linnaeus. Syst. Nat., 10th ed. Vol. 1, p. 41.

Type locality: Bengal, India.

1858. Tigris striatus Severtzov. Rev. Mag. Zool. 10: 386.

(renaming of *tigris*).

1867.. *Tigris regalis* Gray. Proc. Zool. Soc. London. p. 263 . (renaming of *tigris*).

1916. *Panthera tigris* (Linnaeus), *in* Pocock . Ann. Mag. Nat . Hist. 8(19): 306.

Distribution: Kumaon, Nepal Terai southwest to Burma; peninsular India eastward to southeast Asia.

Nepal Records: Hodgson (1834b, p. 96), Gray (1846, p. 4: 1863b, p. 3), Hinton and Fry (1923, p. 96), Chesemore 1970, p. 165).

NEP: 3 specimens: Mitchell - 2; Maser - 1.

Habitat: The tall elephant grass complex and sal forests of the Terai and Rapti Dun, 100 to 900 m.

Field Notes: The tiger is a richly colored, powerfully built carnivore. The head is heavily built, the front shoulders and chest are massive and the hind quarters are slender. The tail is about half the head and body length. The fur is short and the color varies with age and season. The rich colored orange coat with black stripes and a white belly is possessed by young tigers and animals in winter pelage. The summer pelage and coats of old tigers are pale whitish yellow. Both sexes have a ruff or a fringe of fur which begins above and in front of the ear and extends to the throat. This ruff is longer in males and older animals. Males and females differ in size, the large male measuring 2.75 to 3.2 m from tip of nose to tip of tail and weighing

100 to 180 kg.

Hodgson (in Gray 1846) recorded the former distribution of the tiger as "the hills close to the snow and the Terai." They once ranged up to 2300 m in the midlands. Their present range is restricted to the dense jungles of the eastern Terai, Rapti Dun and western Terai. It is estimated that there are fewer than 1500 tigers left in continental India and Nepal; the number remaining in Nepal is unknown.

Tigers prowl a certain territory, or beat, in search of food. When they kill an animal, they drag the carcass into dense undergrowth or tall elephant grass to conceal it from hyaenas, jackals, leopards and vultures, remaining close by to protect it. These large cats eat vast amounts of meat, up to 22 kg, at one time. Then they do not have to feed for several days.

Tigers kill large game animals and livestock by breaking their necks, never by ham-stringing. I witnessed only one case in which the prey was not bitten through the back of the neck. During three years of study, I found the following types of animals were killed by tigers: cows (Bos taurus), domestic buffalo (Bubalus babalis), chital (Axis axis), nilgai (Boselaphus tragocamelus) and wild boar (Sus scrofa). Tigers also feed on carrion. At Gulari a tiger killed a buffalo but abandoned the kill. Natives threw the carcass into the river. Five days later, the tiger

retrieved it from the river and devoured the remains.

According to Schaller and Selsam (1969), deer can run faster than tigers. When chital deer (Axis axis) spot a prowling tiger, they immediately sound their alarm call and stamp their hooves. At Bahwanipur, Banke District, the chital alarm call was heard. Upon investigation, two tigers roared and the deer were frightened away.

Tigers make a number of different calls which have been described at length by Schaller (1967). At evening and during mating season, they repeatedly utter a loud guttural roar. On one occasion a large male was heard to hiss like a domestic cat. The "pooking" of a tiger has a remarkable resemblance to the alarm call of the sambar (Cervus unicolor). It is a loud, clear "pok" repeated several times in succession.

The peak breeding season is from November to about February. The gestation period is about 15 to 16 weeks and the young, usually two to three, but as many as six, are born between February and May (Schaller 1967). Cubs remain with the female until they are two years old. Prater (1965) placed the life span of tigers at about 30 years.

ECTOPARASITES

Ixodoidea: Haemaphysalis anomala
H. bispinosa
H. ramachandrai

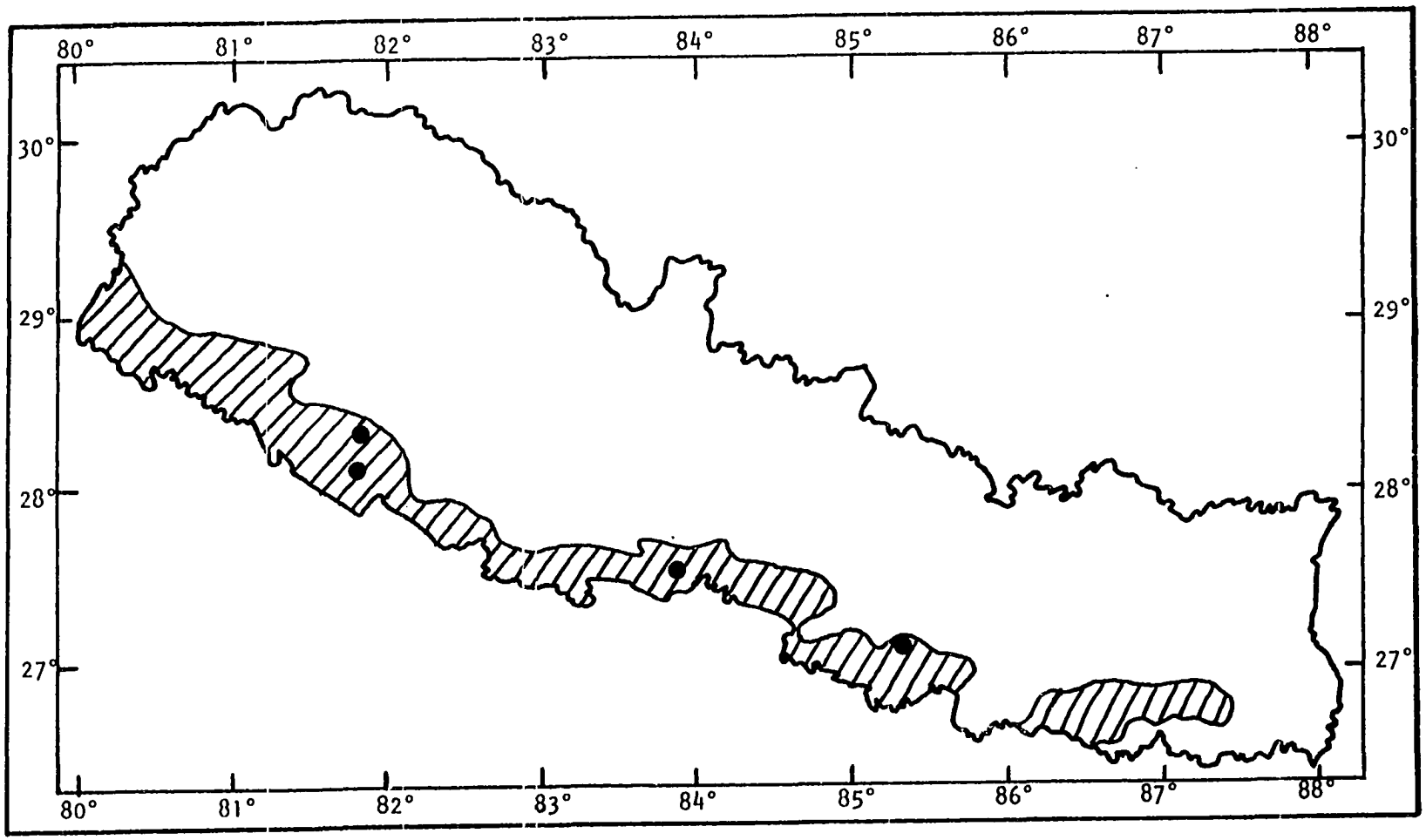


Fig. 65. Collection sites and estimated distribution for Panthera tigris

Panthera uncia uncia (Schreber, 1776)

Ounce or Snow leopard

1776. *Felis uncia* Schreber. Säugeth. 3: pl. 100 (1776) and text pp. 386, 586.

Type locality: unknown.

1830. *Felis irbis* Ehrenberg. Ann. Sci. Nat. 21: 394, 406. (renaming of *uncia*).

Type locality: Altai Mountains.

1846. *Leopardus uncia* Gray. Cat. Hodgson's Cat. B. M. p. 5.

Type locality: Tibet.

1855. *Felis uncioides* Horsfield (Hodgson MS). Ann. Mag. Nat. Hist. 16: 105.

Type locality: Nepal.

1867. *Uncia irbis* Gray. Proc. Zool. Soc. London. p. 276.

Type locality: Tibet.

1930. *Uncia uncia* Pocock. J. Bombay Nat. Hist. Soc. 34(2): 311.

1966. *Panthera uncia* (Schreber), *in* Ellerman and Morrison-Scott. Checklist Palaearctic and Indian Mamm. 2nd ed. p. 320.

Distribution: Eastern Russian Turkestan, Pamirs, north of Altai Mountains, Tibet, Kashmir, Nepal, Sikkim, Bhutan.

Nepal Records: Gray (1846, p. 5; 1863b, p. 3), Horsfield (1855, p. 105), Biswas and Khajuria (1957, p. 238).

Habitat: The Tibetan steppe biotope of the Mustang District and the northern areas of the inner Himalayas, 3000

to 5000 m.

Discussion: The snow leopard has an elongate body and limbs. It has a distinctive, short muzzle, a high forehead and a vertical chin. The ears are short and rounded; the thick, furry tail is more than three-quarters the length of the head and body. The fur is long, dense and woolly,a very pale whitish gray above, sometimes with a yellowish tinge, and white below. A pattern of indistinct rosettes occurs on the back and flanks. The head and body length is 1200 to 1500 mm, the tail length 900 to 1000 mm and the weight 25 to 40 kg.

The relatively large skull is compressed in length and broadened in the region of the brain case. The nasals are short and the upper canines are large (Pocock 1930).

Snow leopards are found in the subalpine and alpine regions of the northern Himalayas. Generally avoiding forested areas, they seek refuge in rocky crags and ravines. Little is known about their life history. They hunt at night, preying on blue sheep (Pseudois nayaur), musk deer (Moschus moschiferus), hares (Lepus oiostolus), larger birds and livestock. Snow leopards follow the downward migration of animals, moving from high alpine valleys to the fringes of birch-conifer forests in winter. The gestation period is about 93 days, and the number of young per litter is usually two to four (Walker et al. 1964b).

During January and February, 1969, a leopard killed

five cows at Dhorpatan, Dolpa District, 2700 m. Although it was never sighted, I suspect that it was an ounce. In March, 1969, natives reported that a snow leopard had killed 32 of their livestock near Goom Village, Mugu District.

Snow leopards are probably more elusive than rare. Over 100 skins of these animals were seen at furriers in New Delhi, Calcutta and Kathmandu. Most of the skins were from Kashmir. Two snow leopard skins were seen in Nepal: one at Melumche, Sindu District and the other at Maharigaon, Jumla District.

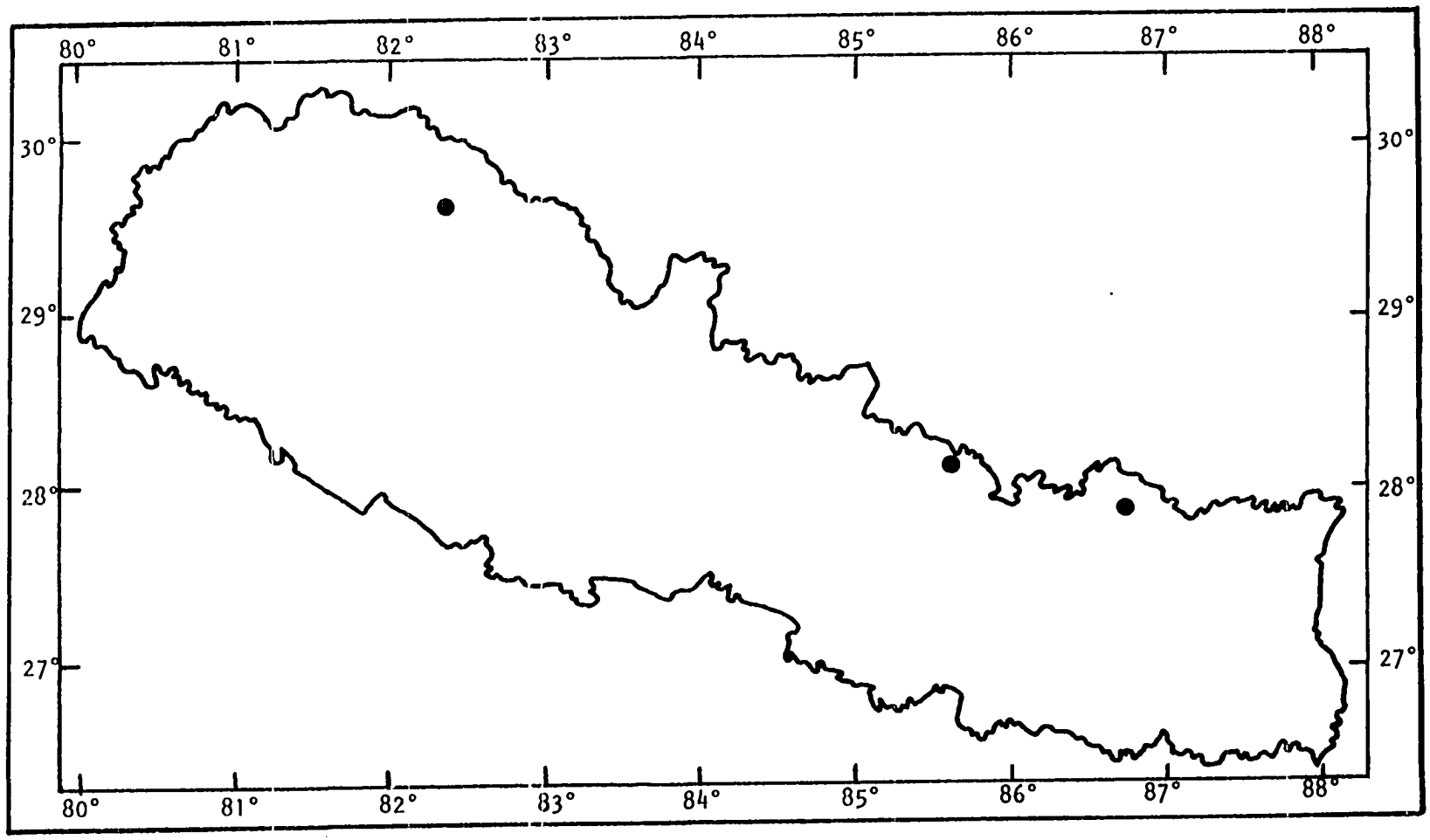


Fig. 66. Sightings for Panthera uncia

ORDER PROBOSCIDEA

Elephas maximus indicus G. Cuvier, 1797

Indian Elephant

1797. *Elephas indicus* Cuvier. Tabl. Elem. H. N., p. 148.

Type locality: India.

1797. *Elephas asiaticus* Blumenbach. Hand. Naturg. ed. 5: 124.

Type locality: "Asia, chiefly Ceylon".

1841. *Elephas indicus* var. *tridactylus* Hodgson. J. Asiat. Soc. Bengal 10(2): 911.

Type locality: Ceylon.

1841. *Elephas indicus* var. *heterodactylus* Hodgson. J. Asiat. Soc. Bengal 10(2): 911.

Type locality: Nepal Terai.

1845. *Elephas indicus bengalensis* Blainville. Osteogr. Mamm. p. 353, pl. iii.

Type locality: Bengal.

1847. *Elephas sumatranus* Temminck. Coup. d'oeil Poss. Neer. 2: 91.

Type locality: Sumatra.

1916. *Elephas maximus maximus* of Lydekker. Cat. Ungulates B. M. Vol. 5, p. 82 (Not of Linnaeus, 1758).

Distribution: Sri Lanka, India, Nepal Terai, Bhutan Duars, Assam, Burma, Southeast Asia, Sumatra.

Nepal Records: Hodgson (1834b, p. 98; 1841e, p. 911), Gray (1846, p. 35), Hinton and Fry (1923, p. 428), Chesemore (1970, p. 165).

NEP: 1 sighting: Mitchell - 1.

Habitat: Dense sal forests and elephant grass complex of the Terai and duns, to the base of the Himalayas.

Discussion: Hodgson (1834b) contended that there were two varieties or perhaps species of the Indian elephant, one from Ceylon and the other from the sal forests of Nepal. He (1841e) named the Ceylonese variety tridactylus and the sal forest type heterodactylus, separating them on the basis of the number of nails on the hind feet: tridactylus usually having three nails and heterodactylus five.

The most conspicuous external feature in elephants is the elongated, flexible and muscular trunk or proboscis. The trunk is actually an elongation of the nose, with the nostrils located at the tip. The head is huge and the ears large and fan-shaped. The neck is short and the body is long and massive. The tail is of moderate length and the long, massive limbs are columnar in shape. The body covering is scant with the hairs long, stiff and bristly. The skin is dark gray to brown, often mottled about the forehead, ears and base of the trunk. The testes are internal in males and females have a single pair of pectoral mammae. The length of the head and body is 5.5 to 6.5 m, the length of the tail 1.2 to 1.5 m, the height at the shoulder 2.5 to 3 m and the weight about 5000 kg (Walker et al. 1964b).

The dental formula is: i. 1/0; c. 0/0; pm. 0/0;

m. 3/3 = 14. The incisors form conical tusks which may measure 2.5 m in length. Generally only the males have large tusks. The tusks of females barely protrude (Lydekker 1916).

Gregarious, elephants roam about in herds of 15 to 20, feeding in the early morning, evening and at night. The diet consists of grasses, leaves, tender shoots, fruit and field crops. They can do extensive damage to sugar cane and rice paddies. According to Blanford (1891), a full grown elephant will consume between 270 to 320 kg of green fodder a day. There seems to be no definite breeding season. The gestation period is 600 to 650 days (20 months) and one or sometimes two young are born from September through November. Individuals have been known to live over 100 years in captivity, and Blanford (1891) felt that in the wild state they may live to 150 years.

In Nepal, Indian elephants are rare in the wild state. A few herds remain scattered throughout the dense sal forests from the Terai to the base of the Himalayas. There is no exact count of the number of elephants remaining in Nepal, but the chief forest officer of the Nepalganj District estimated that in 1970 there were somewhere between 100 to 125 individuals left. Chesemore (1970) sighted wild elephants near Birganj, Parsa District, and Spillett and Tamang (1966) reported elephant herds from the Rapti River Valley, Chitwan District. In December, 1968, I saw fields

of sugar cane that elephants had destroyed in Bara District. On 6 May, 1968, 15 elephants were sighted from helicopter in a dense sal forest near the confluence of the Karnali and Girwa Rivers, Bardia District.

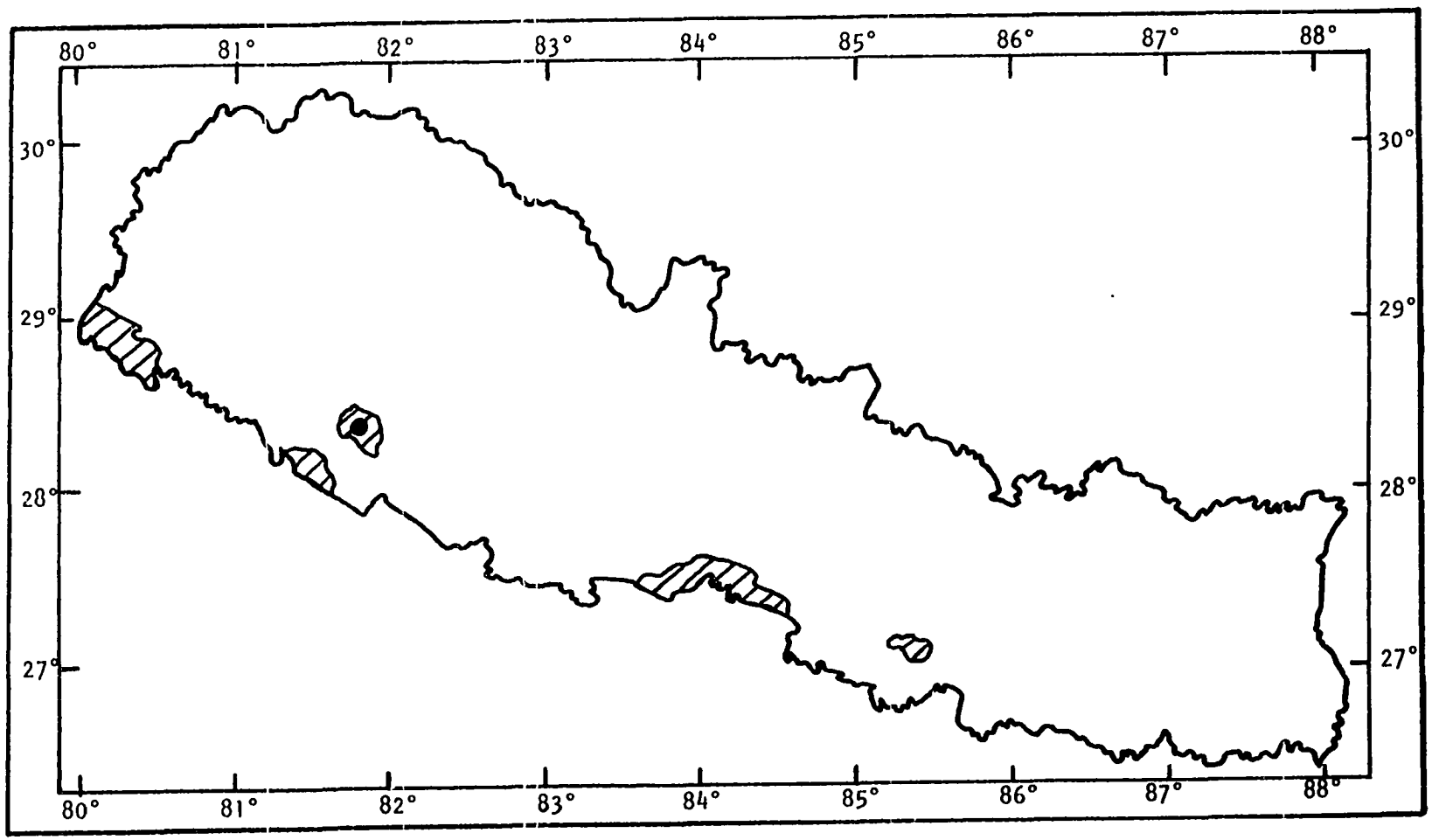


Fig. 67. Sightings and estimated distribution for Elephas maximus

ORDER PERISSODACTYLA

Rhinoceros unicornis Linnaeus, 1758

Great One-horned Rhinoceros, Indian Rhinoceros

1758. Rhinoceros unicornis Linnaeus. Syst. Nat. 10th ed. Vol. 1, p. 56.

Type locality: Subhimalayan Terai of Assam (Lydekker).

1817. Rhinoceros indicus Cuvier. Regn. Anim. 1: 239.

1830. Rhinoceros asiaticus Blumenbach. Hand. Naturg. ed. 12: 107.

1867. Rhinoceros stenocephalus Gray. Proc. Zool. Soc. London. p. 1018.

Type locality: Asia.

Distribution: The Nawal Parasi and Chitwan Districts of Nepal, northern Bihar, Bhutan Duars, Assam.

Nepal Records: Hodgson (1834b, p. 98), Gray (1846, p. 35), Hinton and Fry (1923, p. 427), Stracey (1957, p. 763), Gee (1959a, p. 59; 1959b, p. 137; 1959c, p. 484; 1963, p. 67), Willan (1965a, p. 159; 1965b, p. 159), Spillett and Tamang (1966, p. 557), Chesemore (1970, p. 165).

NEP: 2 sightings: Mitchell - 2.

Habitat: The elephant grass complex and swampy areas of the Reu-Rapti Valley.

Discussion: The Indian rhinoceros is a large, awkward looking creature with a big head, short, stumpy limbs, small eyes and wide nostrils. It has a single "horn" on the upper

surface of the nose. It is composed of agglutinated hairs and has no firm attachment to the bones of the skull. There are three toes on each foot. The skin, which is covered with large convex tubercles, has a number of loose folds, giving the animal the appearance of wearing armor. It is practically naked except for a fringe of stiff hairs around the ears and on the tip of the tail. The color varies from gray to black with a pinkish hue on the underparts and on the margins of the skin folds. There is a single pair of inguinal mammae. The length of the head and body is 2.1 to 4.2 m, the tail length 0.5 to 0.75 m, the height at the shoulders 1.3 to 2 m and the weight 2000 to 4000 kg (Walker et al. 1964b).

The skull is elongate with a prominent occipital crest. The nasal bones are large and united. The small tympanics do not form auditory bullae.

Formerly, the great one-horned rhinoceros inhabited the grasslands of the entire Terai, but at present they are restricted to an area of approximately 1000 sq km in the Rapti and Reu River Valleys of the Chitwan and Nawal Parasi Districts. Preferring swampy ground, they inhabit the uncultivated alluvial plains of the Rapti Valley. Rhinos are fond of rolling in mud and many wallows are to be seen in the Tamispur area. They are more or less solitary, but several animals may inhabit the same tract of elephant grass. Their diet consists of grasses, reeds and young shoots, and

they are known to invade rice paddies. The gestation period is approximately 19 months; a single young is born between February and April. The life span may exceed 50 years.

Habitat destruction and poaching have drastically reduced their numbers. Powdered rhino "horn" is sold as an aphrodisiac, a single horn bringing as much as $2000 (U.S.) in Hong Kong.

Rhinos usually are not aggressive animals. They seek to escape rather than to attack. However, on occasion they have been known to charge an elephant. At Meghauli (Tiger Tops Hotel), one elephant was seriously injured by a rhino. Contrary to popular belief they use their sharply pointed lower tusks, rather than the horn, for defense.

Recent surveys have recorded the decline of the rhino in the Nepal Terai. In 1957, Stracey estimated that about 400 were left in the entire country. Gee (1959a, b & c) reported only 300 rhinos and by 1963, the number had been reduced by poaching to 160. Willan (1965b) reported an increase in the population and sighted 35 rhino calves that year. In 1966, Spillett and Tamang estimated that only 180 animals remained and in 1970, Caughley (personal communication on 18 February 1970 with Dr. Graeme Caughley, United Nations Development Program, Kathmandu, Nepal) surveying the area by helicopter, counted between 125 and 150.

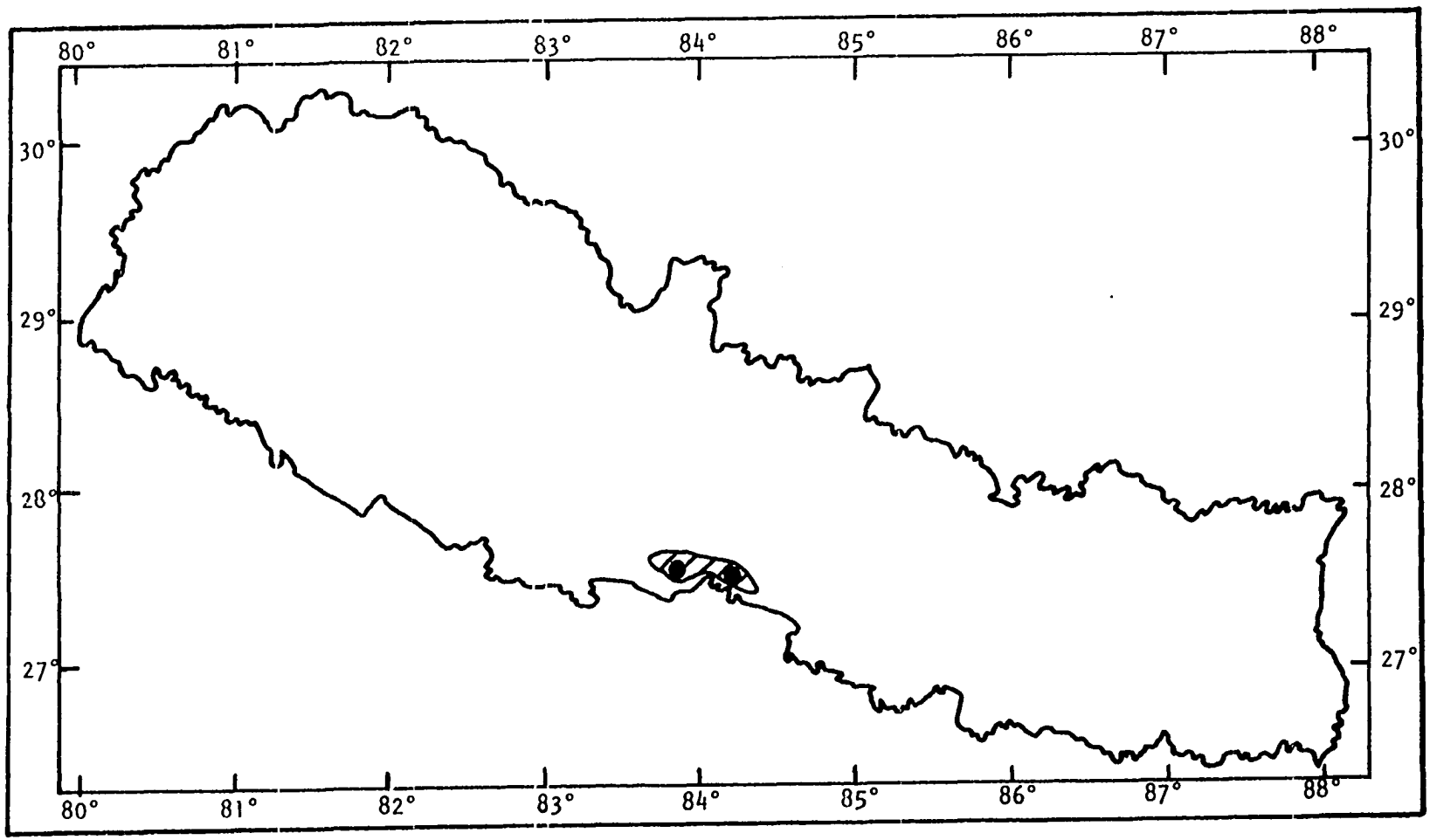


Fig. 68. Sightings and estimated distribution for Rhinoceros unicornis

ORDER ARTIODACTYLA

Sus scrofa cristatus Wagner, 1839

Wild Boar

1839. Sus cristatus Wagner. Muenchen Gelehrt. Anz. 9: 435.

Type locality: Malabar Coast, India.

1842. Sus aper var. aipomus Hodgson. J. Asiat. Soc. Bengal 10: 911.

Type locality: Nepal.

1842. Sus aper var. isonotus Hodgson. J. Asiat. Soc. Bengal 10: 911.

Type locality: Nepal.

1843. Sus indicus Gray. List. Mamm. B. M. p. 185.

1847. Sus affinis Gray. Cat. Osteol. B. M. p. 71.

Type locality: Nilgiri Hills, India.

1851. Sus zeylonensis Blyth. J. Asiat. Soc. Bengal 20: 173.

Type locality: Ceylon.

1860. Sus bengalensis Blyth. J. Asiat. Soc. Bengal 29: 105.

Type locality: Bengal.

1883. Sus vittatus cristatus Major. Zool. Anz. 6: 296.

1900. Sus cristatus typicus Lydekker. Great and Small Game of India. p. 261.

1915. Sus cristatus cristatus Lydekker. Cat. of Ungulates, Mamm. Vol. 4, p. 319.

Type locality: Malabar Coast, India.

1966. Sus scrofa cristatus Wagner, in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 345.

Distribution: Sri Lanka and Indian subcontinent: Pakistan, Nepal, Darjeeling, Sikkim, Bhutan, Assam, Burma.

Nepal Records: Hodgson (1841e, p. 911), Gray (1846- p. 35), Hinton and Fry (1923, p. 427), Caughley (1969, p. 7), Chesemore (1970, p. 165).

NEP: 7 specimens: Mitchell - 4; Maser - 3.

Habitat: Every major life zone of Nepal except the Tibetan steppe, from 100 to 4500 m.

Field Notes: The wild boar is characterized by a long head and a long snout that has a rounded terminal pad for rooting. The neck is short and the body is long and heavy set. The legs are relatively short. The body is covered with stiff hairs and there is a crest of black bristles extending from the nape down along the back. The color is black mixed with gray, rusty brown or dirty white. Females have six pairs of mammae. The head and body length is 1.2 to 1.8 m, the tail length about 300 mm and the shoulder height about 1.0 m. In males, the weight is 100 to 230 kg and in females 60 to 150 kg.

The rostrum is elongated, comprising about half of the length of the skull. The nasals are also greatly elongated. There is a pronounced postorbital process with a corresponding projection on the jugal bone. The dental formula is: i. 3/3; c. 1/1; pm. 4/4; m. 3/3 = 44 (Allen 1940). The first two upper incisors are broad and laterally com-

pressed; the third incisor is small. The canines (tusks) curve outward and upward in both jaws. The molars and last premolars are bunodont.

Wild boar have the widest altitudinal range of any large ungulate inhabiting Nepal. They are found in the scrub jungle and tall grass complex of the Terai and duns, the deciduous broadleaf forests of the foothills and the oak-rhododendron forests and bamboo thickets of the midlands. In Langtang Valley, a wild boar was sighted at an altitude of 4500 m.

Wild boars are generally nocturnal, resting in undergrowth or thickets during the day. They travel in herds of 10 to 12, sometimes up to 50 are found together. Prater (1965) contended that wild boars are omnivorous, but they prefer roots and tubers. They do extensive damage to grain crops and fields of potatoes. Wild boars also feed on carrion.

Females have one to two litters of three to eight young each season. Walker et al. (1964b) reported a gestation period of 112 to 115 days. The piglets have a characteristic striped coat consisting of a median black stripe with an ochreous stripe beginning laterally at the nape. This striped pattern alternates laterally, breaking up into spots on the haunches. In the Terai, piglets have been seen as early as May and June, and in the midlands as

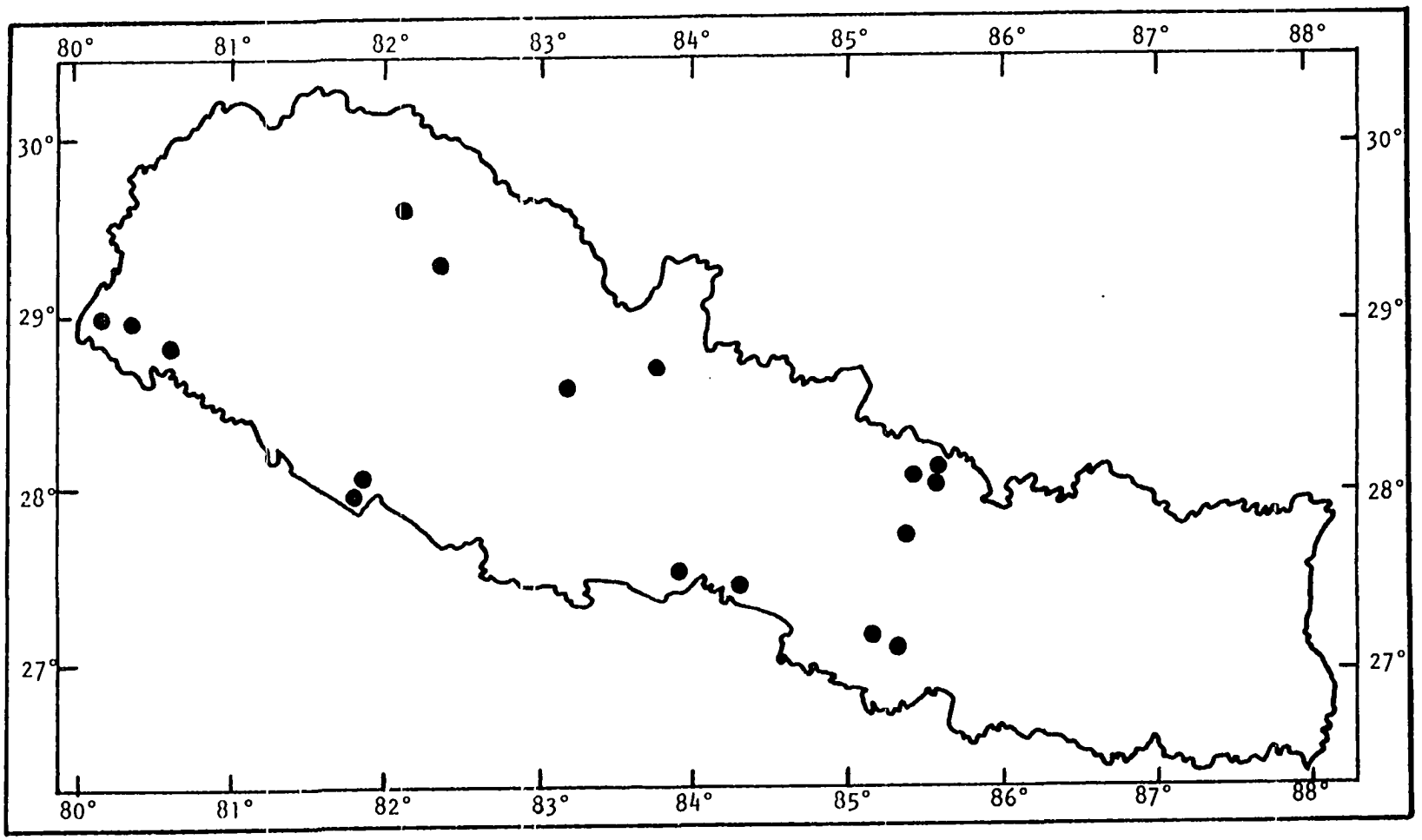


Fig. 69. Collection sites and sightings for Sus scrofa

late as October and November.

It is reported (Allen 1938; Blanford 1891; Prater 1965) that females have the habit of building a nest for reception of the young. While hunting deer in March, my guide stepped on such a nest and the female came bursting out of its cover. The nest, hollowed into the hill side, was situated at the base of a ridge. The inside was lined with grasses covered over with stems of perennial shrubs. Bushes in the immediate vicinity had been neatly severed as though they had been cut with a knife. According to the literature, males also construct nests.

ECTOPARASITES

Ixodoidea:	Dermacentor auratus
	Haemaphysalis aborensis
	H. bispinosa
	Hyalomma marginatum isaaci
	Rhipicephalus haemaphysaloides
Anoplura:	Haematopinus suis

Sus salvanius (Hodgson, 1847)

Pygmy Hog

1847. Porcula salvania Hodgson. J. Asiat. Soc. Bengal 16: 423. pls. 12 and 13.

Type locality: Sikkim Terai, India.

1863. Sus lilliputensis Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 15 (nom. nud.)

1867. Porculis salvanis Jerdon. The Mamm. of India. p. 244.

1883. Sus salvanius (Hodgson), in Garson. Proc. Zool. Soc. London. p. 143.

1904. Sus (Porcula) salvianus Trouessart. Cat. Mamm. Suppl. 663.

1915. Sus (Porcula) salvanius (Hodgson), in Lydekker. Cat. of Ungulates, Mamm. Vol. 4, p. 343.

Distribution: The sal forest tract along the base of the Himalayas: Nepal, Sikkim Terai, Bhutan Duars, Assam.

Nepal Records: Horsfield (1855, p. 114).

Habitat: The moist forest tract at the base of the eastern Himalayas.

Discussion: Hodgson (1847a) was the first to describe the pygmy hog; he placed it in a genus of its own, Porcula. Lydekker (1915) later transferred it to the genus Sus and retained Porcula as the subgenus. Ellerman and Morrison-Scott (1966) agreed to the separation of Sus salvanius subgenerically on account of the small size, the very short tail and the presence of three pairs of mammae as opposed to six in Sus. Because Tate (1947) felt that salvanius may have been based on young specimens of the Indian wild boar, he did not consider it a separate and distinct species.

The pygmy hog is brown or blackish brown in color. There is no distinct crest, but the bristles on the nape and middle of the back are rather long. The ears are small and naked. The length from the snout to the vent is 460 to 510 mm, the tail length 25 to 30 mm, the shoulder height 200 to

260 mm and the weight 4 to 5 kg (Hodgson 1847b; Blanford 1891).

The dental formula is: i. 3/3; c. 1/1; pm. 3/3; m. 3/3 = 40. The canines are small and straight; they do not extend beyond the lips (Blanford 1891).

Blanford (1891) stated that the pygmy hog has habits similar to those of the Indian wild boar and that it is found chiefly in tall jungle grass. The scarcity of sightings since 1900 led experts to believe that the pygmy hog was extinct. Mallinson (1971) reported observations made on 14 adults and four young that were captured in Assam. When an extensive fire burned about 70 sq km of tall grass jungle, these animals were captured while fleeing the flames.

Since pygmy hogs are nocturnal and inhabit the tall elephant grass complex, they could still be present in the western Terai and Rapti Dun. Domesticated pigs similar in stature to the pygmy hog are common in the Pokhara Valley.

Tragulus meminna (Erxleben, 1777)

Indian Spotted Chevrotain, Mouse-deer

1777. Moschus meminna Erxleben. Syst. Regn. Anim. Mamm. p. 322.

Type locality: Ceylon.

1842. Tragulus minenoides Hodgson. J. Asiat. Soc. Bengal 10: 914.

Type locality: Nepal Terai.

1843. Meminna indica Gray. List. Mamm. B. M. p. 172.

1864. Tragulus meminna Milne-Edwards. Ann. Sci. Nat. Zool. Ser. 2(5): 160.

1920. Moschiola meminna Wroughton. J. Bombay Nat. Hist. Soc. 27(2): 308.

Type locality: India.

Distribution: Sri Lanka, peninsular India to Nepal Terai.

Nepal Records: Hodgson (1841e, p. 914), Hinton and Fry (1923, p. 427).

NEP: 2 sightings, 1 partial skeleton: Mitchell - 3.

Habitat: Elephant grass biotope and sal forests of the Terai and duns.

Taxonomic Notes: Although these small, graceful animals resemble deer, they belong to a group of artiodactyls which seem to be more closely related to camelids (Camelidae) and pigs (Suidae) than to deer (Cervidae) (Walker et al. 1964b). According to Lydekker (1915), they resemble the Section Pecora in that: (1) the upper incisors are absent, (2) the stomach has three chambers, (3) the metacarpal and metatarsal bones are fused in a single bone, the cannon bone, and (4) the antlers are lacking in both sexes. He therefore placed them in their own separate Section: Tragulina, and Family: Tragalidae.

Field Notes: The mouse-deer is a tiny creature with very slender limbs and a somewhat robust body. The canines

are long and tusk-like in males. There are four fully developed toes. The coloration is a rich brown above with rows of white spots on the flanks which elongate into lateral bands on the shoulders. There are three white stripes on the throat. The underparts are white. Two pairs of mammae are present. The head and body length is 250 to 400 mm, the tail length 50 to 60 mm, the shoulder height 250 to 300 mm and the weight 3 to 5 kg.

Chevrotains are nocturnal and solitary in habit, living in thick undergrowth and tall grasses. Their diet consists mainly of grasses and herbaceous material. Mating generally takes place before the monsoons (June through early July) and one, rarely two, young are born approximately 150 to 160 days after mating.

On 18 February at Tamispur, Nawal Parasi District, a chevrotain was sighted in a clump of tall elephant grass. A second animal was seen at Mahadeva, Banke District, when it was frightened from the dense undergrowth. In March of 1970, natives from Gulari, Banke District, brought in a carcass of a male chevrotain that they had killed three days before. It had been captured in the dense thorn-brush thickets growing along the Rapti River.

Hodgson (1841e) reported the Nepal Terai as the collection site for his specimen of mouse-deer, but Blanford (1891) contended that "Hodgson included it in his list of

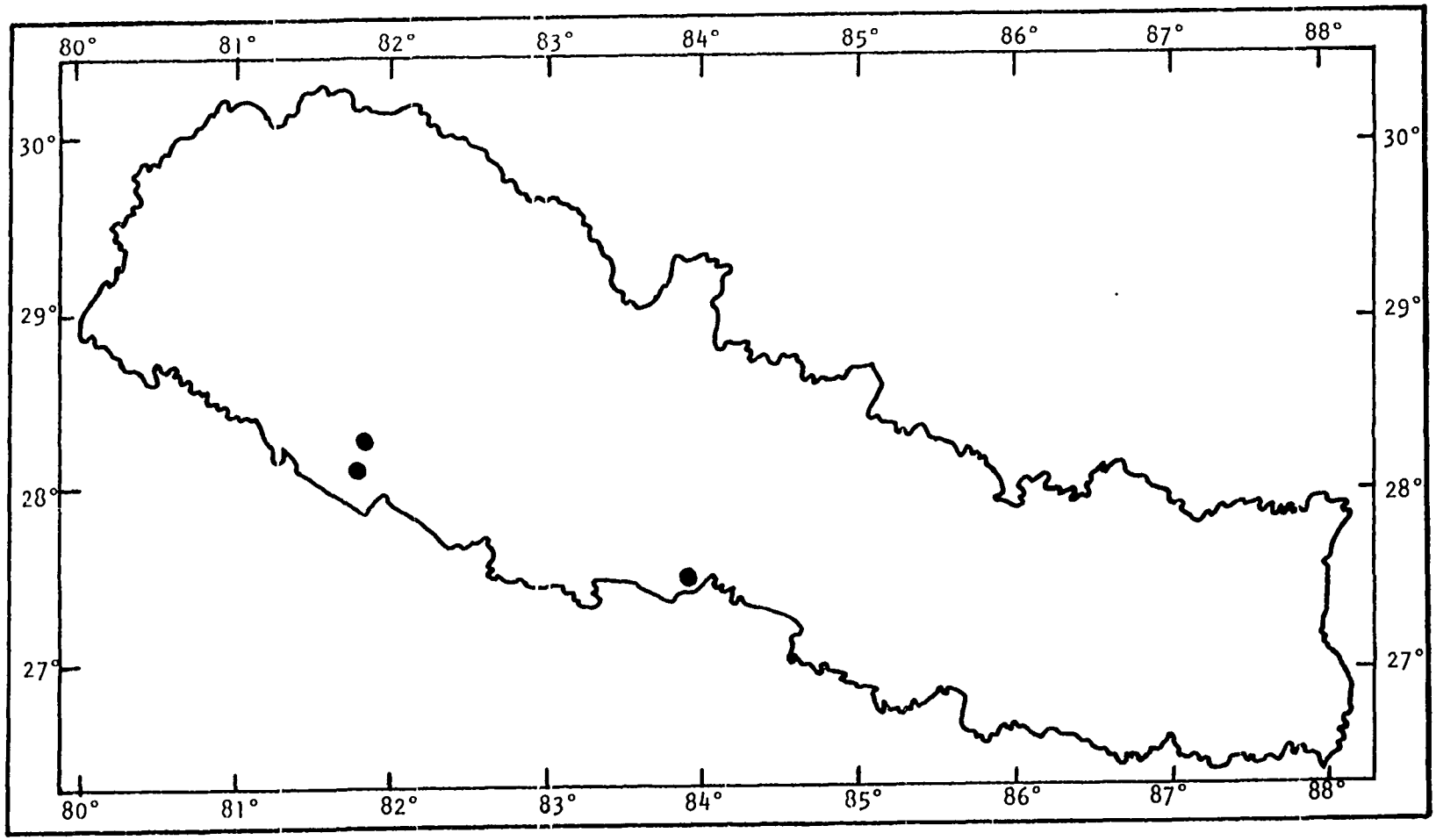


Fig. 70. Sightings for Tragulus meminna

Nepal mammals, but he appears never to have obtained a specimen." Gray (1846, 1863b) does not list the mouse-deer in his two catalogues on Hodgson's collections. Champion (1929) felt that Hodgson's record was inaccurate since no specimen in his collection could be found in the British Museum.

Champion (1929) reported that 24°N latitude is approximately the northern limit for this species, but sightings of the mouse-deer in the western Terai extended the range beyond 28°N.

Moschus moschiferus moschiferus Linnaeus, 1758

Musk Deer, Kasturi

1758. Moschus moschiferus Linnaeus. Syst. Nat. 10th ed. Vol. 1, p. 66.

Type locality: Tartary (Mongolia).

1830. Moschus altaicus Eschscholtz. Isis (Oken), p. 606.

Type locality: Mongolia.

1839. Moschus chrysogaster Hodgson. J. Asiat. Soc. Bengal 8: 203.

Type locality: Nepal.

1839. Moschus leucogaster Hodgson. J. Asiat. Soc. Bengal 8: 203.

Type locality: Nepal.

1839. Moschus saturatus Hodgson. J. Asiat. Soc. Bengal 8: 203.

Type locality: Nepal.

1848. Odontodorcas moschiferus Gistel. Naturgesch. Tierreichs. p. 82.

1872. Moschus moschiferus maculatus Gray. Cat. Rum. Mamm. B. M. p. 96.

1872. Moschus moschiferus fasciatus Gray. Cat. Rum. Mamm. B. M. p. 96.

1872. Moschus moschiferus concolor Gray. Cat. Rum. Mamm. B. M. p. 96. (The above three names were based on vernacular names of Milne-Edwards, 1864. Ann. Sci. Nat. Zool. 2: 62).

1915. Moschus cacharensis Lydekker (Hodgson MS). Cat. Ungulates, Mamm. Vol. 4, p. 6 (nom. nud.)

Type locality: Nepal Kachar.

Distribution: Altai and Sayan Mountains, Tibet, Mongolia, Kashmir, Nepal, Sikkim, Bhutan, northern Burma.

Nepal Records: Hodgson (1839a, p. 203), Gray (1846, pp. 30-31), Hinton and Fry (1923, p. 427), Fry (1925, p. 530), Biswas and Khajuria (1957, p. 239), Caughley (1969, p. 6).

NEP: 1 skin: Mitchell - 1.

Habitat: Subalpine and alpine regions of the midlands and inner Himalayas, possibly the alpine desert biotope of the Mustang District; 2400 to 4500 m.

Field Notes: Musk deer are the most primitive of all living deer. They are robust in build with an elevated rump and a very short tail. They differ from other cervids in that a gall bladder is present. Antlers are lacking in both sexes and males have long upper canine teeth, 60 to 70 mm in length, which extend far below the upper lip. In females

the canines are smaller and never protrude below the lower lip. Foot glands are lacking, but males possess large caudal and preputial glands. The coat of brittle, hollow hairs is coarse and thick. It is rich dark brown mottled with light gray. The color may vary with season and age (Whitehead 1972). Two pairs of inguinal mammae are present. The head and body length is 800 to 1000 mm, the tail length 40 to 50 mm, the shoulder height 500 to 600 mm and the body weight 10 to 12 kg.

Musk deer inhabit rhododendron, coniferous and birch forests of the midlands and inner Himalayas. They are found at high elevations along the base of rocky outcroppings and in bamboo thickets. Solitary in habit, they are active in early morning and late evening. They sleep in hollowed-out beds beneath overhanging cliffs and large boulders and their diet consists of grasses, moss, lichens and alpine flowers. Mating usually takes place in December or January. The gestation period is about 160 days and a single young, rarely two, is born sometime in June.

Due to heavy poaching, musk deer have been eliminated over much of their original range. The "musk pod", or preputial gland, is worth more per gram than gold for musk is used in perfumes and as an aphrodisiac. The skins, teeth and musk pods are common items for sale in apothecary shops and bazaars throughout Nepal. At Rara Lake, Mugu District,

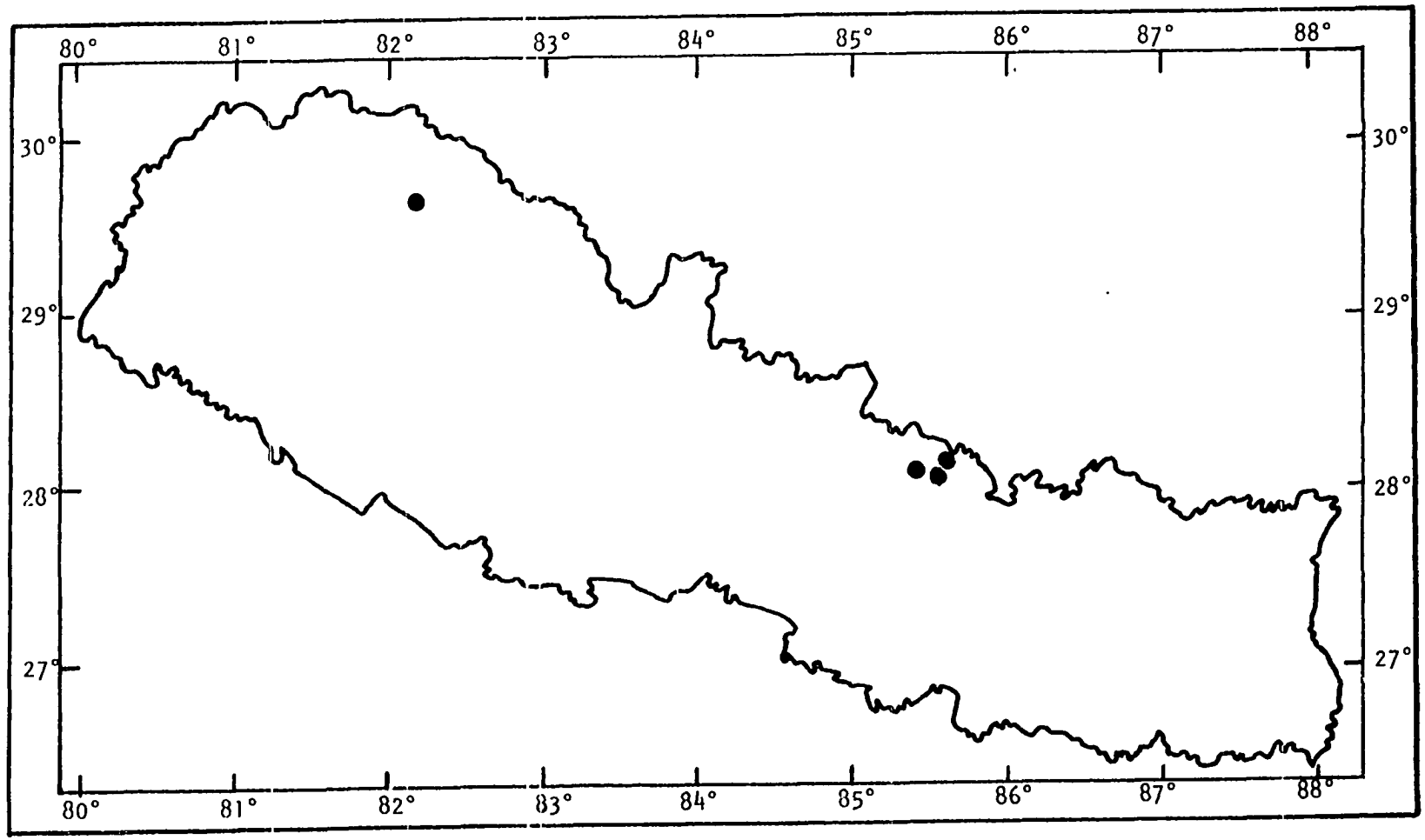


Fig. 71. Sightings for Moschus moschiferus

the teeth are worn as amulets. In June, 1970, a hunter killed a male above Melumche, Sindu District. Hair and droppings of these deer were found around Gosainkund Lakes, Nuwakot District. At Langtang Valley, a musk deer was noted entering a dense rhododendron forest.

Muntiacus muntjak vaginalis (Boddaert, 1785)

Indian Muntjak, Barking Deer, Ratwa

1785. Cervus vaginalis Boddaert. Elench. Anim. Vol. 1, p. 136.

Type locality: Bengal.

1833. Cervus ratwa Hodgson. Asiat. Res. 18(2): 139.

Type locality: Nepal.

1840. Cervus melas Ogilby, in Royle. Illustr. Bot. Himalaya. Lxxiii.

Type locality: India.

1841. Stylocerus ratwa Hodgson. J. Asiat. Soc. Bengal 10: 914.

Type locality: Nepal.

1845. Cervus styloceros Schinz. Synop. Mamm. 2: 549. (renaming of melas Ogilby, 1840).

1846. Muntjacus vaginalis Gray. Cat. Hodgson's Coll. B. M. p. 31.

1846. Styloceras muntjak Cantor. J. Asiat. Soc. Bengal 15: 269.

1852. Stylocerus muntjacus Kelaart. Prodromus Faunae Zeylan. p. 85 (renaming of vaginalis).

1867. Cervulus vaginalis Jerdon. The Mamm. of India. p. 264.

1891. Cervulus muntjak Blanford. The Fauna Brit. India, Mamm. p. 532.

1913. Muntiacus vaginalis Wroughton. J. Bombay Nat. Hist. Soc. 21(4): 825.

Type locality: Bengal.

1914. Cervulus muntjak vaginalis Lydekker. Ward's Records of Big Game. 7th ed., p. 80.

Type locality: Bengal.

1915. Muntiacus muntjak vaginalis (Boddaert), in Lydekker. Cat. of Ungulates, Mamm. Vol. 4, p. 21.

Distribution: Kashmir, Uttar Pradesh, Nepal, Darjeeling, Sikkim, Bhutan and Assam.

Nepal Records: Hodgson (1833b, p. 139; 1834b, p. 99; 1841e, p. 914), Gray (1846, p. 31), Hinton and Fry (1923, p. 426), Fry (1925, p. 530), Caughley (1969, p. 6), Chesemore (1970, p. 166).

NEP: 12 specimens: Mitchell - 10; Maser - 2.

Habitat: Moist and dry deciduous forests of the Terai and duns, evergreen broadleaf forests of the Siwaliks and Mahabharats and coniferous forests of the midlands; 100 to 3300 m.

Field Notes: Muntjaks have a wide distribution over the Indian subcontinent. Three races are recognized for the region: M. m. vaginalis in the northern areas, M. m. aureus in peninsular India and M. m. malabaricus in south India and Sri Lanka (Whitehead 1972).

Muntjaks are small, high-rumped deer with tusk-like

upper canines. Their small antlers consist of a basal brow-tine and a main beam mounted on long, bony pedicels which continue downward as prominent, convergent ridges on the frontal region of the skull. Antlers are lacking in females and the pedicels are represented by tufts of bristly hair and small bony prominences. The suborbital glands are large and a pair of frontal glands is found on the inner surfaces of the frontal ridges. The color is bright chestnut above and rufous on the underparts and flanks. Old males tend to be darker. The head and body length is 800 to 1000 mm, the tail length 100 to 150 mm, the shoulder height 450 to 550 mm and the weight 15 to 20 kg.

Barking deer have the greatest altitudinal range of any cervid in Nepal. Although common in the Terai (100 to 300 m), they are most abundant in the midlands (2000 to 3300 m). Muntjaks are solitary and are active in the early morning and late evening. Their loud, dog-like bark can be heard throughout the day. Individuals have been heard to call continuously for over an hour.

Barking deer feed on grasses and browse, and in the fall, on oak mast. The stomach contents of one male contained over 200 acorns. Blanford (1891) reported the rutting season in northern India as January and February, with a gestation period of six months. Young are born in June and July. In the midlands, mating takes place in

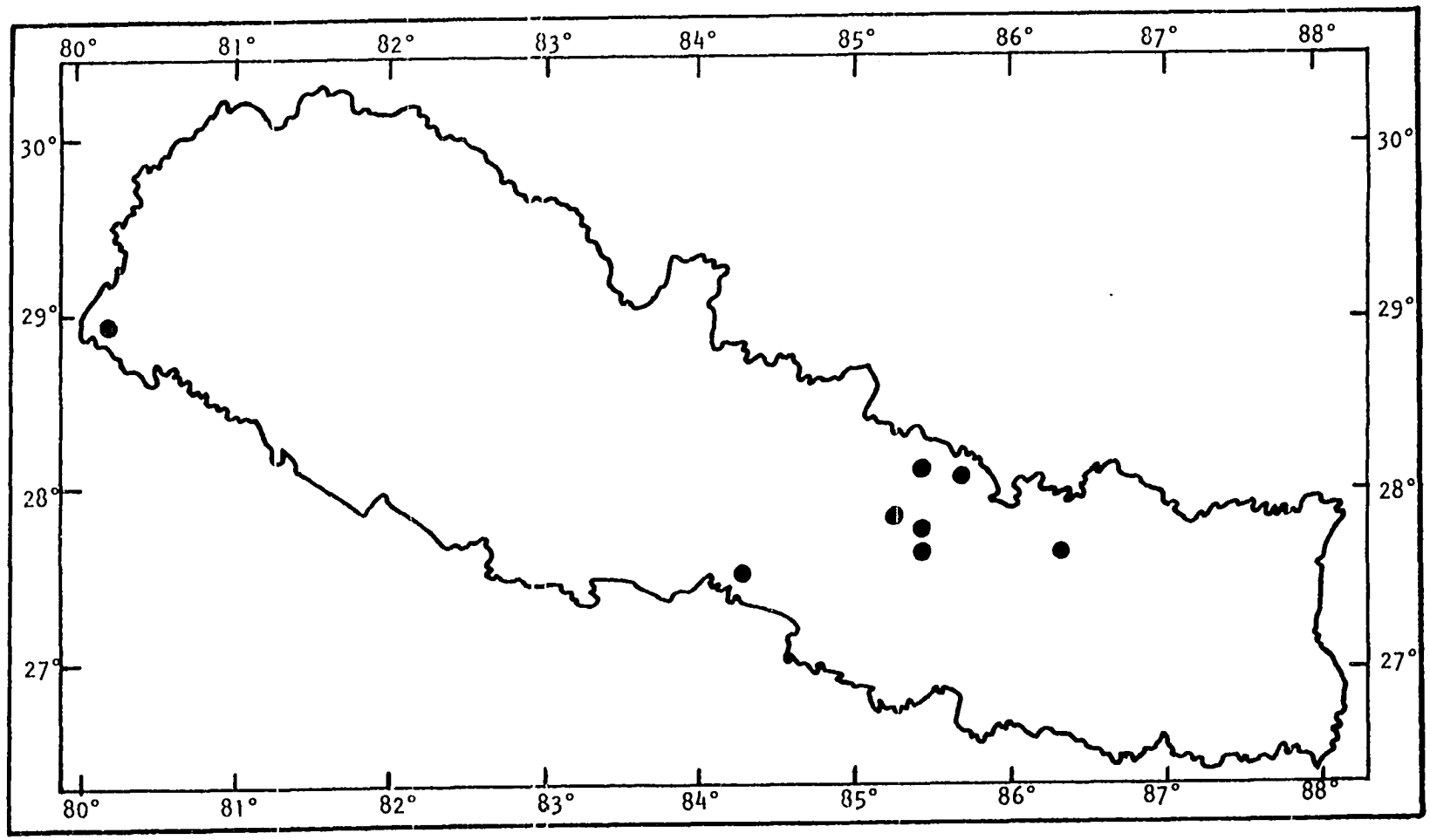


Fig. 72. Collection sites and sightings for Muntiacus muntjak

November and December and fawns are dropped in March and April. A pregnant female, collected in March, was carrying a nearly fully developed foetus.

ECTOPARASITES

Siphonaptera:	*Ancistropsylla nepalensis*
Ixodoidea:	*Boophilus microplus* *Haemaphysalis aponommoides* *H. birmaniae* *H. bispinosa* *H. himalaya* *Ixodes acutitarsus* *I. nuttallianus* *I. lindbergi* (="*ovatus*")
Diptera:	*Lipoptena pauciseta*
Anoplura:	*Solenopotes muntiacus*

Axis axis axis (Erxleben, 1777)

Chital, Axis Deer, Spotted Deer

1777. *Cervus axis* Erxleben. Syst. Regn. Anim. p. 312.

Type locality: Banks of the Ganges, India.

1792. *Cervus axis maculatus* Kerr. Anim. Kingd. p. 300.

Type locality: Banks of the Ganges.

1829. *Cervus axis* var. *indicus* Fischer. Syn. Mamm. p. 619.

1831. *Cervus nudipalpebra* Ogilby. Proc. Zool. Soc. London. 1830-31. p. 136.

Type locality: Banks of the Ganges.

1842. *Axis major* Hodgson. J. Asiat. Soc. Bengal 10(2): 914.

1842. *Axis minor* Hodgson. J. Asiat. Soc. Bengal 10(2): 914.

1843. Axis maculata Gray. List. Mamm. B. M. p. 178.

1846. Cervus (Hippelaphus) axis Sundevall. K. Svenska Vet. Ak. Handl. p. 180.

1867. Axis maculatus Jerdon. The Mamm. of India. p. 260.

1910. Axis (Axis) axis (Erxleben), in Pocock. Proc. Zool. Soc. London. p. 948.

1915. Cervus (Axis) axis Lydekker. Cat. Ungulate Mamm. Vol. 4, p. 49.

Type locality: Plains of peninsular India.

Distribution: Peninsular India northward to Uttar Pradesh, Nepal, West Bengal, Bangladesh, Sikkim, Bhutan Duars, western Assam.

Nepal Records: Hodgson (1834b, p. 98; 1841e, p. 914), Gray (1846, p. 32), Hinton and Fry (1923, p. 426), Chesemore (1970, p. 166).

NEP: 23 specimens: Mitchell - 20; Maser - 3.

Habitat: The moist and dry deciduous forests of the Terai, duns and Siwaliks; 100 to 1000 m.

Taxonomic Notes: Flerov (1952) considered the genus Axis to be among the most primitive of the true cervids. Lydekker (1915) regarded Axis as a subgenus of Cervus, but Simpson (1945) elevated it to generic rank, a classification followed by Ellerman and Morrison-Scott (1966).

Hodgson (1841e) reported two species of spotted deer from the subcontinent of India: Axis major, a large variety found in the Nepal Terai and northern India, and Axis minor,

a smaller race found in southern India. Wroughton (1912) and Pocock (1923) recognized only one species, Axis axis, for peninsular India. Ellerman and Morrison-Scott (1966) reported two subspecies of chitals: A. a. ceylonensis of Sri Lanka and A. a. axis of India.

Field Notes: The chital is perhaps the most beautiful of all deer. The coat is a bright rufous fawn covered with white spots and with white underparts. A dark stripe runs from the nape to the tail, bordered along the back by one or two rows of white spots. Males have long, 3-tined antlers, in which the brow-tine forms a right angle with the beam. The beam is forked at the summit. The antlers are 600 to 900 mm in length. Metatarsal and hind-pastern (hoof) glands are present in both sexes. Four inguinal mammae are present. The head and body length is 1.0 to 1.75 m, the tail length 125 to 350 mm and the shoulder height 600 to 900 mm. Males weigh 70 to 85 kg and females 50 to 65 kg.

Chitals are found in the sal forests of the Terai and duns, usually in herds of 10 to 30. Two herds were seen, each totalling over 100 animals. These deer have altered their feeding habits in areas bordering villages. Near villages they feed only from about 11:00 p.m. until early dawn, while in less populated areas they begin feeding early in the evening and eat until about mid-morning before taking to cover.

They feed on both grass and browse, but prefer green grasses and cultivated crops such as mustard and wheat. They are somewhat limited in their movements and range. Over a two year period the same herd of deer was sighted at least five times in a single dense patch of jungle. Studying the range and movements of chitals, Schaller (1972) found that within a single year one herd occupied a total area of only 15 to 20 sq km.

Males shed their antlers in September and October and new antlers are usually in velvet only until the end of December. However, four animals taken in February were still in velvet and bucks have been seen in velvet as late as 15 March.

Breeding season varies throughout the different localities of the Indian subcontinent. In March, stags begin fighting in Nepal and mating occurs during April and May. According to Schaller (1967), mating in India commences in April, the gestation period is eight to eight and one-half months and fawns are dropped in late January and early February. At Gokarna Reserve, Kathmandu District, chitals were observed over a four year period. Mating took place in April and May and in January and February, about eight and one-half months later, fawns were born.

There are conflicting reports as to how many fawns are born at one time. Brandon (1923) stated that one to three

is usual, with twins being common. Prater (1965) and Schaller (1967) reported that a single fawn is usual and twins a rarity. During four years of investigation by the NEP, a set of twins was never encountered in the wild. Four does collected in February and March all carried a single foetus.

ECTOPARASITES

Siphonaptera:	Ancistropsylla nepalensis Ctenocephalides felis orientis
Ixodoidea:	Boophilus microplus Dermacentor auratus Haemaphysalis birmaniae H. bispinosa H. himalaya H. indica H. ornithophila H. ramachandrai H. spinigera Hyalomma marginatum isaaci Ixodes lindbergi (="ovatus")
Diptera:	Lipoptena axis L. timida
Anoplura:	Solenopotes capillatus

Axis porcinus porcinus (Zimmermann, 1780)

Hog Deer, Laguna

1777. Cervus porcinus Zimmermann. Spec. Zool. Geogr. p. 532. (Zimmermann, 1777 is not an available work).

Type locality: Bengal.

1780. Cervus porcinus Zimmermann. Geogr. Gesch. 2: 131.

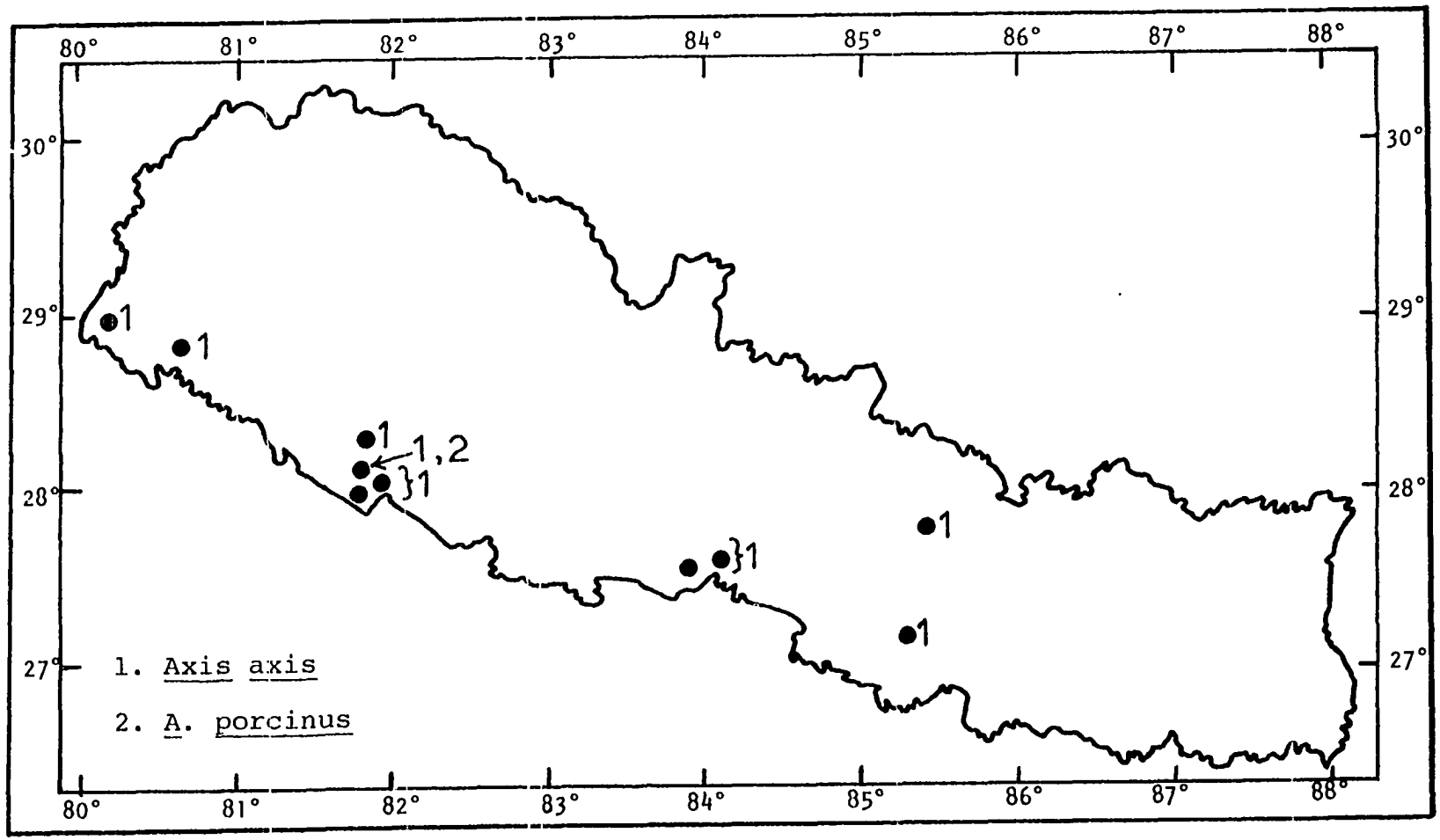


Fig. 73. Collection sites for Axis axis and A. porcinus

Type locality: Bengal.

1827. Cervus pumilio. H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 120.

1835. Axis porcinus Jardine. Naturalist's Libr. Mamm. Vol. 3, p. 169, pl. 14.

1844. Cervus (Hyelaphus) porcinus Sundevall. Svenska Vet. Ak. Handl. p. 181.

Type locality: Indo-Gangetic Plain of India.

1850. Hyelaphus porcinus Gray. Proc. Zool. Soc. London. p. 233.

Type locality: India.

1852. Axis oryzus Kelaart. Prodromus Faun. Zeylanicus. p. 83.

Type locality: Ceylon.

1883. Cervus minor Sclater. List. Anim. Zool. Gardens. p. 169.

Type locality: India.

1910. Axis (Hyelaphus) porcinus (Zimmermann), in Pocock. Proc. Zool. Soc. London. p. 950.

Distribution: Sri Lanka, but not peninsular India, the Indo-Gangetic Plain from the Sind and Punjab to Kumaon, Nepal, West Bengal to Assam, Burma and Indo-China.

Nepal Records: Hodgson (1834b, p. 98), Gray (1846, p. 33), Hinton and Fry (1923, p. 426), Chesemore (1970, p. 166).

NEP: 3 specimens: Mitchell - 3.

Habitat: The grassy alluvial plains and thornbrush thickets of the Terai and Rapti Dun.

Field Notes: The hog deer is low and heavy in build; the legs and face are short. The color is uniform brown or yellowish brown above, the underparts paler or rufous. Faint white spots are visible on does and young bucks. The small antlers (300 to 500 mm in length) are set upon very long, bony pedicels. The head and body length is 900 to 1200 mm, the tail length 200 to 250 mm, the shoulder height 600 to 700 mm and the weight 30 to 45 kg.

Hog deer inhabit dense scrub jungle and grassy thickets of the lowland plains. Mainly nocturnal, they feed in early morning and late evening, their diet consisting of grass, browse, berries, wheat and mustard. Hog deer rarely congregate in herds; they usually occur singly or in pairs. According to Jerdon (1867), rutting begins in September and the gestation period is eight months. Prater (1965) stated that young are born in April and May. Schaller (1967) reported that they mate in July with fawns dropped the following March. In March of 1970, a lactating female was collected at Gulari, Banke District.

ECTOPARASITES

Ixodoidea: *Dermacentor auratus*
Haemaphysalis bispinosa

Cervus unicolor niger Blainville, 1816

Sambar

1816. *Cervus niger* Blainville. Bull. Soc. Philom. Paris. p. 76.

1823. *Cervus aristotelis* Cuvier. Ossemens Fossiles. 2nd ed. Vol. 4, p. 503.

Type locality: Nepal.

1823. *Cervus leschenaulti* Cuvier. Ossemens Fossiles. 2nd ed. Vol. 4, p. 506.

Type locality: Coromandel, India.

1827. *Cervus hippelaphus* H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 105.

Type locality: Bengal.

1831. *Cervus jarai* Hodgson. Gleanings in Science 3: 321.

Type locality: Nepal.

1841. *Rusa nepalensis* Hodgson. J. Asiat. Soc. Bengal 10(2): 914. (*nom. nud.*)

Type locality: Nepal.

1841. *Rusa heterocervus* Hodgson. J. Asiat. Soc. Bengal. 10(2): 914. (*nom. nud.*)

1843. *Axis pennantii* Gray. List. Mamm. B. M. p. 180.

Type locality: India.

1846. *Rusa hippelaphus* Gray. Cat. Hodgson's Coll. B. M. p. 33.

1891. *Cervus unicolor* Blanford. The Fauna Brit. India, Mamm. p. 543.

1910. *Rusa unicolor* Pocock. Proc. Zool. Soc. London. p. 946.

1943. Rusa unicolor Pocock. J. Bombay Nat. Hist. Soc. 44 (1): 30.

Type locality: Northern India.

1966. Cervus unicolor niger Blainville, in Ellerman and Morrison-Scott. Checklist Palaearctic and Indian Mamm. 2nd ed. p. 362.

Distribution: Peninsular India to the Himalayas; Kumaon and Nepal.

Nepal Records: Hodgson (1831c, p. 321; 1841c, p. 721; 1841e, p. 914), Gray (1846, p. 33), Hinton and Fry (1923, p. 427), Chesemore (1970, p. 166).

NEP: 4 specimens: Mitchell - 3; Maser - 1.

Habitat: The sal forests of the Terai and Rapti Dun; the Dundwa and Churia hills to the south of the Siwaliks.

Taxonomic Notes: Gray (1843, 1846) and Pocock (1910, 1943) considered Rusa a valid genus, but Lydekker (1915) and Ellerman and Morrison-Scott (1966) assigned it as a subgenus of Cervus. Hodgson (1831c, 1841e) reported three species of sambar from Nepal: jarai, heterocervus and nepalensis. The latter two are without description and are therefore nomina nuda.

Field Notes: The sambar is the largest of all Nepalese deer and males have massive antlers 800 to 1200 mm in length. The antlers, consisting of three tines, are borne on short pedicels. The brow-tine is set at right angles to the main or posterior beam, which forks toward the

apex. The antlers are shed in December and January. The coat is coarse and shaggy, forming a mane on the nape and throat. Large suborbital glands are present, but hind pastern glands are lacking. Females are generally brown with a grayish tinge and old bucks are dark blue or almost black. The sambar stands nearly 1.5 m high at the shoulder and weighs 250 to 350 kg.

Found in both dry and moist deciduous forests, these deer inhabit the lower foothills of the Siwaliks and the undulating areas of the Terai from 300 to 1000 m. During the hot, dry season they wallow in mudholes. They are rarely seen in large numbers, although 11 were driven from the undergrowth of the Dundwa Hills, Banke District, by our native beaters. Their food consists of grass, leaves and various kinds of wild fruit. They feed mainly at night, retiring into heavy brush at daybreak.

Over a three year period, four sambars were observed at Gokarna Reserve, Kathmandu District. Mating took place in October and November and fawns (one or two) were born the following May. The gestation period was 230 to 240 days. In February, 1968, a female carrying a single fawn was shot by hunters at Tamispur, Nawal Parasi District.

When alarmed, sambars utter a snorting whistle, followed by a sharp "pok" repeated several times. Also, they begin "pooking" when they approach the kill of a tiger or

when they catch the sight or scent of a tiger. I once observed a doe with fawns at Gokarna, Kathmandu Valley. Immediately, she detected danger, but could not locate the source. She gave a sharp whistle, then stamped her hooves repeatedly. When irritated, sambars will enlarge and contract the suborbital glands. Natives believe that they enlarge this gland to entrap flies.

ECTOPARASITES

Ixodoidea:
Boophilus microplus
Dermacentor auratus
Haemaphysalis anomala
H. bispinosa
H. ramachandrai
Hyalomma brevipunctata
H. detritum

Cervus duvauceli duvauceli G. Cuvier, 1823

Swamp Deer, Barasingha

1823. Cervus duvaucelii G. Cuvier. Oss. Foss. ed. 2, 4:505. (Based on sketches of antlers by Duvaucel.)

1834. Cervus bahrainja Hodgson. Proc. Zool. Soc. London. p. 99. (nom. nud.)

Type locality: Nepal.

1835. Cervus elaphoides Hodgson. J. Asiat. Soc. Bengal 4: 648. (substitute for bahrainja).

1843. Cervus dimorphe Hodgson. J. Asiat. Soc. Bengal 12: 897.

Type locality: Sal forests of Morang, Nepal.

1846. Cervus (Hippelaphus) duvauceli Sundevall. Svenska Vet. Akd. Handl. p. 178.

1846. Recervus duvaucellii Gray. Cat. Hodgson's Coll. B. M. p. 33.

1846. Rusa dimorpha Gray. Cat. Hodgson's Coll. B. M. p. 33.

Type locality: Sal Forest, Morang.

1847. Rucervus duvaucelii Hodgson. J. Asiat. Soc. Bengal 16: 689.

1850. Cervus euceros Gray. Knowsley Menagerie. p. 61, pl. 40.

Type locality: India.

1868. Cervus eucladoceros Falconer. Pal. Mem. 1: 587.

Type locality: West bank of Ganges, south of Hardwar, Uttar Pradesh, India.

1910. Cervus (Rucervus) duvauceli Cuvier, in Ward. Records of Big Game. 6th ed., p. 79.

Distribution: India, north of the Ganges from Kumaon to Assam: Indo-Gangetic Plain, eastern Sundarbans, western Terai of Nepal.

Nepal Records: Hodgson (1834b, p. 99; 1835c, p. 648; 1841c, p. 721; 1843b, p. 897), Gray (1846, p. 33), Hinton and Fry (1923, p. 427), Chesemore (1970, p. 166).

NEP: Several sightings: Mitchell.

Habitat: Grasslands and reed beds along major rivers and swampy areas and dry and moist deciduous forests of the western Terai.

Field Notes: The swamp deer is a large cervid with an elongate muzzle, a neck mane and unique antlers. The antlers are somewhat flattened and both the second and third tines are lacking. The beam forks dichotomously, one or both

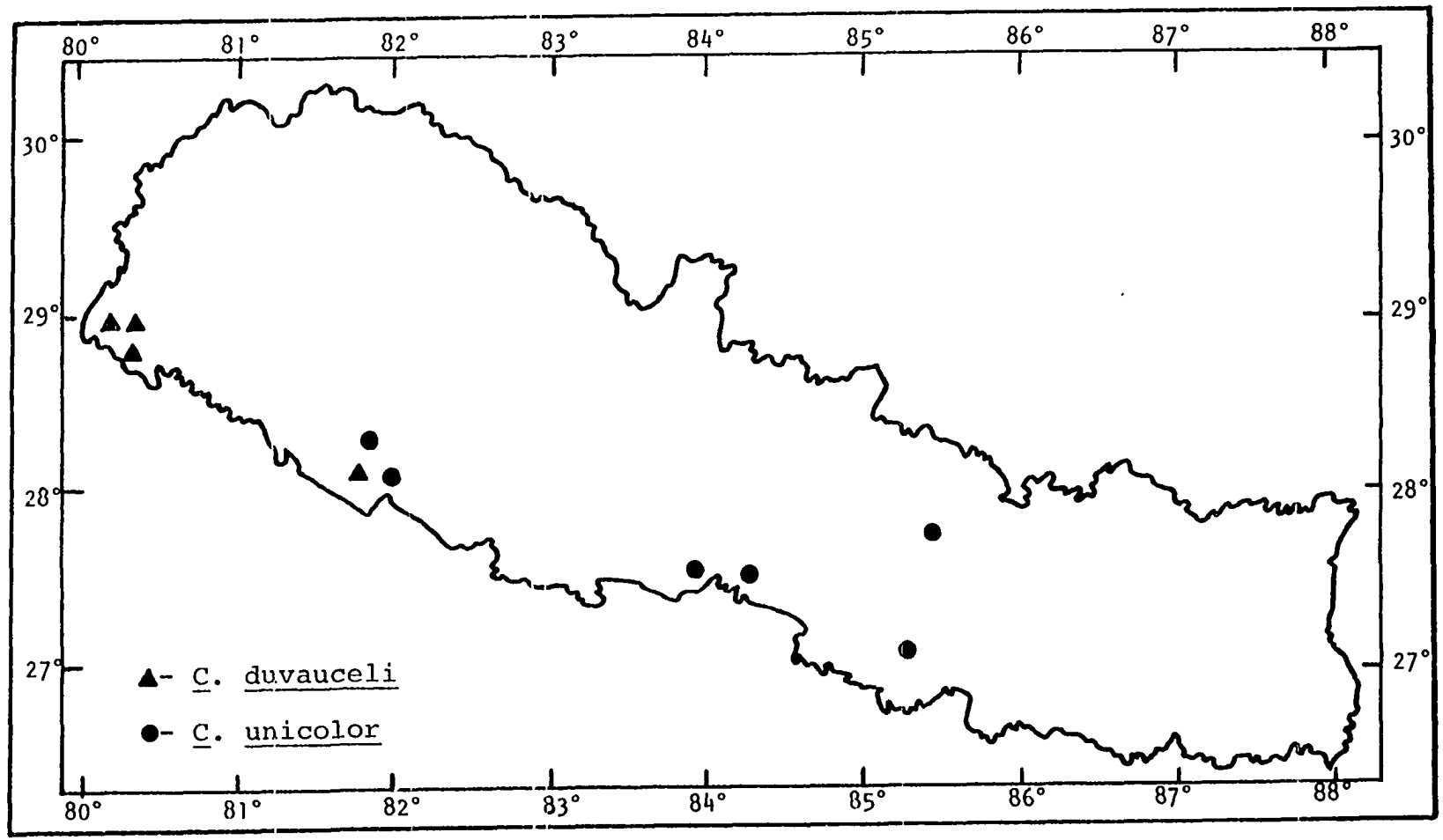


Fig. 74. Collection sites and sightings for Cervus sp.

branches fork again. There are usually 12 tines altogether. The summer coat is a bright rufous brown. Down the middle of the back there is usually a broad brown stripe, bordered on each side by a row of white spots. The throat, inner sides of the thighs and underparts are white or whitish. The lower surface of the tail is pure white. In winter, the dorsal pelage is yellowish brown, and the underparts are pale brown. The head and body length is 1.3 to 1.8 m, the tail length 300 to 375 mm, the shoulder height 1 to 1.2 m and the weight 160 to 200 kg.

Swamp deer avoid dense jungles, inhabiting alluvial flood plains and swampy lowlands that are covered with tall grasses and sissoo (Dalbergia sp.). Previously, they were distributed throughout the suitable river basins of the Indus, Ganges and Brahmaputra rivers, but the species has disappeared from the western part of its range (Schaller 1967). Formerly they were widely distributed over the entire western Terai of Nepal; now they are limited to a few scattered areas in the Banke, Bardia, Kailali, and Kanchanpur Districts. Swamp deer are highly gregarious, congregating in herds of 30 to 50. During rut, several hundred animals have been known to gather together. Dr. Fleming, Sr., (personal communication on 8 January 1969 with Dr. Robert L. Fleming, Sr., Director Shanti Bhawan Hospital, Kathmandu, Nepal) reported seeing, in 1952, herds of well over 500 animals in the Bardia District.

Swamp deer feed on grasses and sedges and actively graze throughout the day. Rutting commences in October and stronger males may gather a harem of as many as 30 females (Prater 1965). According to Blanford (1891), the gestation period is approximately six months.

In Nepal, barasingha have so drastically declined in numbers that the continued existence of the species is in doubt. Habitat destruction and poaching have led to this dramatic decline. When malaria eradication began in 1956, large areas of the Terai were opened for agriculture. Reeds and tall grasses have been cut for thatch and livestock have destroyed vast stands of grass along the major streams. Also, motorized hunting has led to large scale slaughter of these deer. Presently, the largest number of swamp deer is found between Mahendranagar and Dhangarhi in the Sukhla Phanta area, a large swampy region bordering the Sarda River. The King's helicopter pilot reported seeing a herd in March, 1968, of 300 to 400 barasingha in this area.

Several herds of 10 to 15 animals were observed in low swampy areas near Mahendranagar, Mahendranagar District. At Gulari, Banke District, a stag and two hinds were sighted at least three times in a dense sal forest bordering the Rapti River (December 1969). According to the Nepalganj District Forest Officer, this was the first sighting of swamp deer in the Banke District in five years. In 1970, natives said that small herds of swamp deer were still found in the forests of

Acacia catechu and Dalbergia sissoo that grow along the Rapti River.

Tetracerus quadricornis (Blainville, 1816)

Four-horned Antelope; Chousingha

1816. Cerophorus (Cervicapra) quadricornis Blainville. Bull. Soc. Philom. Paris. pp. 75 and 78.

Type locality: Plains of peninsular India.

1816. Antilope quadricornis Desmarest. Nouv. Dict. Hist. Nat. 2nd ed. Vol. 2, p. 193.

1825. Antilope chickara Hardwicke. Trans. Linn. Soc. London 14: 520, pls. 15 and 16.

Type locality: Western Provinces of Bengal, Bihar and Orissa, India.

1827. Antilope (Tetraceros) quadricornis H. Smith. Griffith's Cuvier Animal Kingd. Vol. 5, p. 845.

1828. Tetraceros striatocornis Leach, in Brookes. Cat. Mus. p. 64.

1836. Tetracerus chickara Jardine. Naturalist's Libr. Mamm. 4: 224.

1839. Antilope sub-4-cornutus Elliot. Madras. J. Lit. 10: 225.

Type locality: Southern Mahratta country, India.

1843. Tetracerus subquadricornis Gray. List Mamm. B. M. p. 159.

1846. Tetracerus quadricornis (Blainville), in Gray. Cat. Hodgson's Coll. B. M. p. 26.

1847. Tetracerus subquadricornutus Hodgson. J. Nat. Hist. Calcutta 8: 89. (Emendation of sub-4-cornutus).

1848. Tetracerus iodes Hodgson. J. Nat. Hist. Calcutta 8: 90.

Type locality: Sal forests beneath the sub-Himalayas.

1847. Tetracerus paccerois Hodgson. J. Nat. Hist. Calcutta 8: 90.

Type locality: Sal forests beneath the sub-Himalayas.

1895. Tetraceros quadricornis typicus Sclater and Thomas. Book of Antelopes. Vol. 1, p. 215.

Distribution: Peninsular India: from Madras to the base of the Himalayas; Nepal.

Nepal Records: Hodgson (1848, p. 90), Hinton and Fry (1923, p. 425), Chesemore (1970, p. 166).

NEP: 2 sightings: Mitchell - 2.

Habitat: The tall grass complex of the foothills between the Terai and Siwaliks, 300 to 1000 m.

Taxonomic Notes: Several authors prefer to place Tetracerus (four-horned antelope) and Boselaphus (nilgai) into a distinct subfamily, the Boselaphinae. Lydekker (1914) placed Tetracerus in the subfamily Tragelaphinae, which contains the large or medium sized antelopes of Africa. Simpson (1945) grouped it in the subfamily Bovinae under the tribe Boselaphini, where it stands at present.

Field Notes: Four-horned antelope differ from all other existing hollow-horned ruminants by the presence of two pairs of horns in males, of which the first pair is much smaller than the second. The horns are short, conical and smooth. The tail is short and the hooves are small and rounded in front. An elongate suborbital gland is present and

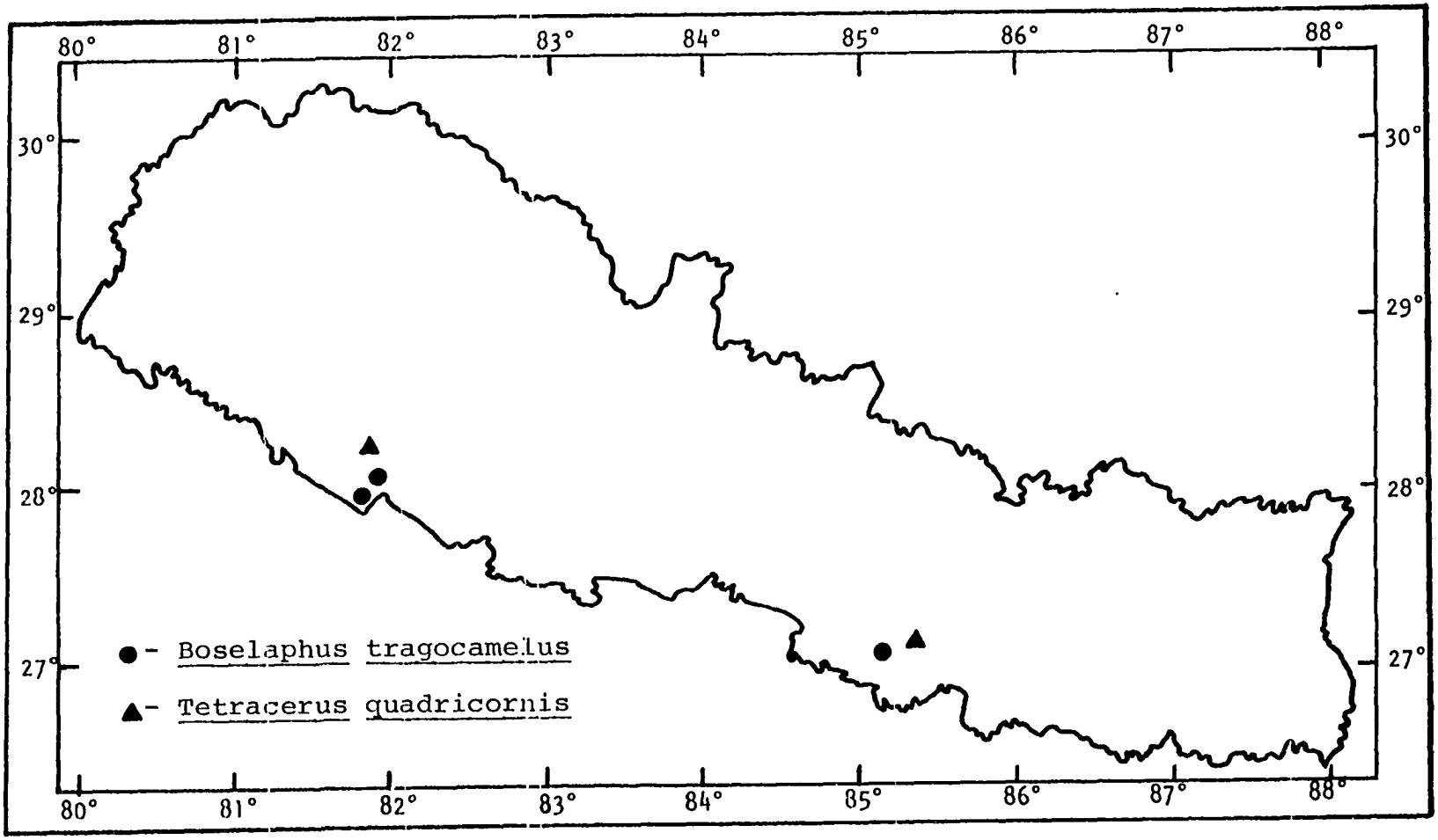


Fig. 75. Collection sites and sightings for subfamily Bovinae

interdigital glands are confined to the hind feet. Chousinghas are similar in appearance to barking deer. They are dull pale brown with a more or less rufous tinge on the back. There is a dark, blackish brown stripe down the front of each leg. The muzzle and outer surface of the ears are blackish. Old bucks are generally yellowish brown. The number of mammae is four. The head and body length is 800 to 1000 mm, the tail length 100 to 130 mm, the shoulder height 500 to 600 mm and the weight 15 to 20 kg.

Chousinghas inhabit hilly terrain, seeking shelter in dense grasses and heavy brush. They are shy creatures that move with a peculiar, jerky gait. They usually occur singly and have the habit of defecating in one place. Mating takes place during monsoons (July through September) and young are born in January or February. The gestation period is approximately 180 days and the litter size is one to two.

Several four-horned antelope were sighted in the dense sal forests near Mahadeva, Banke District, and one buck was flushed from tall elephant grass.

Boselaphus tragocamelus (Pallas, 1766)

Nilgai, Blue Bull

1766. Antilope tragocamelus Pallas. Misc. Zool. p. 5.
Type locality: Plains of peninsular India.

1777. Antilope albipes Erxleben. Syst. Regn. Anim. p. 280.

Type locality: India.

1777. Antilope leucopus Zimmermann. Spec. Zool. Geogr. p. 541.

Type locality: India.

1777. Antilope picta Pallas. Spicil. Zool. Vol. 12, p. 14.

Type locality: India.

1814. Antilope (Bubalis) tragocamelus Lichtenstein. Mag. Nat. Freunde. 6: 164.

Type locality: India.

1816. Boselaphus pictus Blainville. Bull. Soc. Philom. p. 75.

Type locality: India.

1827. Damalis risia H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 363. (Substitute for picta).

Type locality: India.

1836. Portax picta Lesson. Hist. Nat. Mamm. 10: 304.

Type locality: India.

1837. Tragelaphus hippelaphus Ogilby. Proc. Zool. Soc. London. p. 138. (Substitute for picta).

Type locality: India.

1846. Portax tragelaphus Sundevall. K. Svenska Vet. Akad. Handl. 1844, p. 198. (corrected to tragocamelus, 1845: 323).

1883. Boselaphus tragocamelus Sclater. List. Animal Zool. Gardens. p. 137.

Type locality: India.

Distribution: Peninsular India: from Mysore to the Himalayas; Nepal Terai.

Nepal Records: Chesemore (1970, p. 166).

NEP: 4 specimens: Mitchell - 4.

Habitat: The open grassy plains and scrub (Acacia sp.) of the Terai.

Field Notes: The nilgai is the largest antelope that is native to the Terai. The head is long and pointed, the forelegs are somewhat longer than the hind legs and the tail is long. Both sexes have neck manes, and males have a tuft of hair or a "bell" on the throat. The male is iron gray, the underside of the tail, the insides of the ears, the rings on the fetlocks and the underparts are white. The throat tuft and tail are black. The female is smaller with the iron gray areas of the male replaced by tawny fawn. Only males have stout conical horns, which are 150 to 200 mm in length. The height at the shoulders is 1.0 to 1.5 m and adults weigh 175 to 225 kg.

Old bucks are often solitary, but occasionally they associate in herds. Nine males were seen together in one herd. Females and young, together with one or more males, usually make up a herd. Nilgai feed throughout the day and are also active at night. They both browse and graze, often feeding on cultivated crops. They have a habit of defecating in the same spot and large dung heaps accumulate. Nilgai can gallop at a considerable speed and for quite a distance. Two males were chased a distance of 2.5 km, attaining a top speed of 56 km per hour.

Mating takes place during March and April and one to two fawns are born about eight months (240 to 245 days) later. Walker et al. (1964b) and Prater (1965) contended that young are born at all seasons of the year. Females have been seen with young from December through March.

ECTOPARASITES

Ixodoidea:	Boophilus microplus Dermacentor auratus Haemaphysalis bispinosa Hyalomma brevipunctata H. marginatum isaaci
Diptera:	Lipoptena axis
Anoplura:	Haematopinus eurysternus

Bos gaurus gaurus H. Smith, 1827

Gaur or Indian Bison

1827. Bos gaurus H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 399.

Type locality: Mainpat, in Sarguja Tributary States, India.

1827. Bos gour Hardwicke. Zool. Journ. 3: 231.

Type locality: District of Ramgurh, India.

1827. Bos gavaeus Hardwicke. Zool. Journ. 3: 233.

1837. Bibos subhemachalus Hodgson. J. Asiat. Soc. Bengal 6: 499.

Type locality: Sal Forest, Nepal.

1837. Bos cavifrons Hodgson. J. Asiat. Soc. Bengal 6: 747. (substitute for subhemachalus).

1846. Bos gaur Sundevall. Svenska Vet. Akad. Handl. 1844: 201. (Substitute for gaurus).

1846. Bibos gaurus Gray. Cat. Hodgson's Coll. B. M. p. 24.

Type locality: Nepal Terai.

1851. Bos asseel Horsfield. Cat. Mamm. Mus. E. India Co. p. 181.

1867. Gavaeus gaurus Jerdon. The Mamm. of India. p. 301.

1898. Bos (Bibos) gaurus Lydekker. Wild Oxen, Sheep and Goats. p. 23.

Type locality: Hill forests of Indian peninsula.

Distribution: Malay States, Indo-China, Burma, Assam, Bhutan Duars, eastern Nepal Terai, peninsular India south to Travancore.

Nepal Records: Hodgson (1837 a & c, pp. 499, 747), Gray (1846, p. 24), Hinton and Fry (1923, p. 424), Chesemore (1970, p. 166).

Habitat: Undisturbed tracts of sal forests, tall grasslands and moist deciduous forests of the eastern Terai, Rapti Dun and eastern Siwaliks; 300 to 1500 m.

Discussion: The gaur is very large with a massive body, stout limbs and a long tail with a terminal tuft. The muzzle is large, broad and naked. There is a dorsal ridge or hump that begins between the withers and ends abruptly in the middle of the back. Horns are present in both sexes and are flattened at the base, curving strongly inward with inclined tips. The color is typically dark olive brown,

tending to be blackish above with the underparts paler. The forehead to the nape is ash gray. The legs are white or whitish from the knees down. The nearly hairless bodies of old bulls are jet black with white stockings. Females have four teats. Large males have a head and body length of almost 3 m, tail length of 800 to 900 mm, shoulder height of 2.2 m and weight of more than 1 metric ton.

Gaur prefer the rocky, forested foothills of the Siwaliks. They are found in herds of five or six to as many as 20. Old bulls are solitary. They are shy and avoid cultivated lands, feeding in early morning and late evening. Their food consists chiefly of grasses, and they are supposed to be quite fond of bamboo shoots. Old bulls are aggressive and have been known to kill domestic livestock. They mate during the winter months, with a single calf born the following August or September.

Gaur were commonly sighted and reported by hunters from the foothills bordering the Rapti Valley and eastern Terai. The Birganj District Forest Officer reported the poisoning of nine gaur at Shikari Bas, Parsa District (personal conversation, March, 1970). The shyness of these animals and the dense undergrowth which they inhabit make it difficult to estimate the number remaining in Nepal.

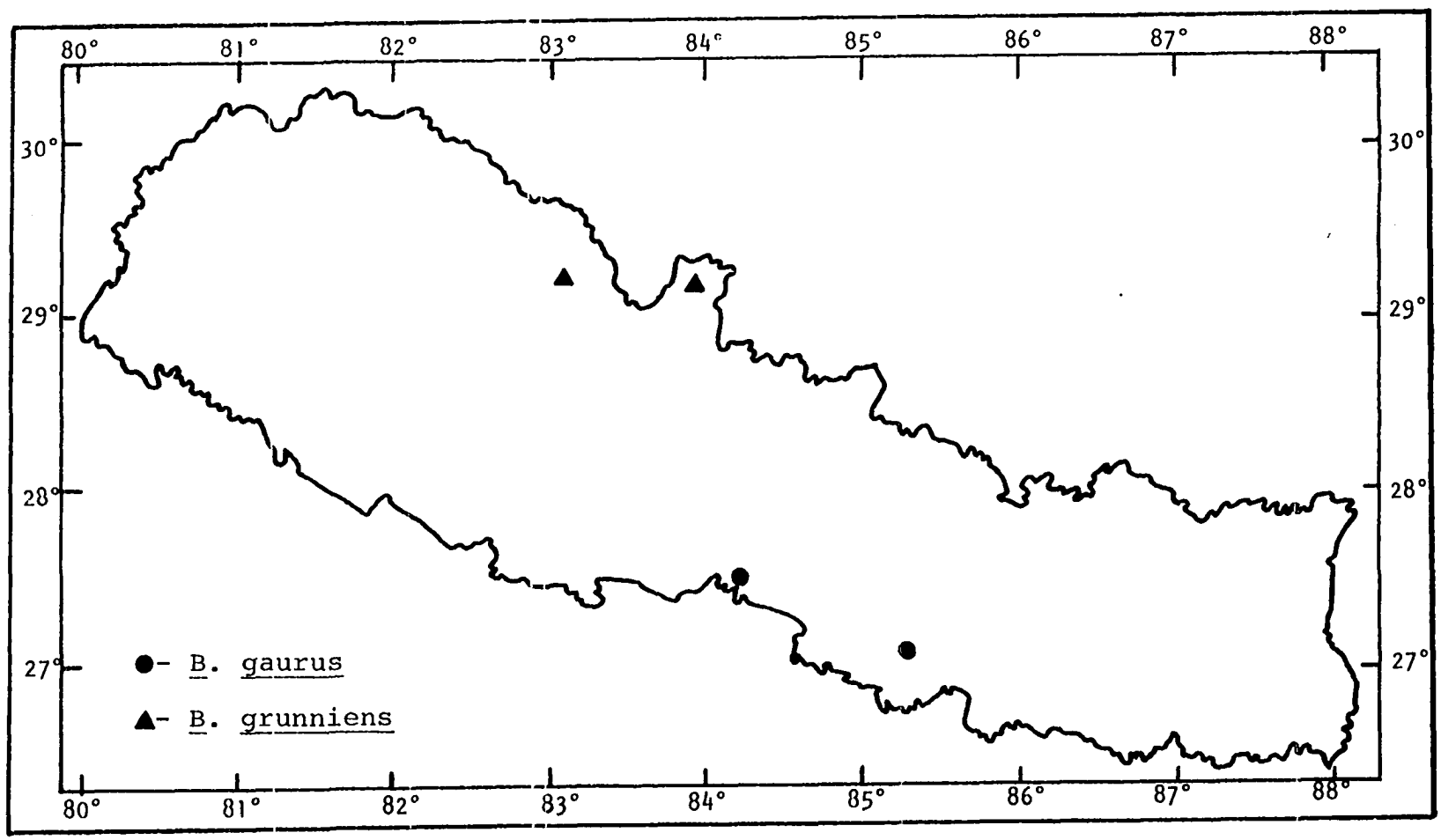


Fig. 76. Sightings of Bos sp.

Bos grunniens grunniens Linnaeus, 1766

Yak

1766. Bos grunniens Linnaeus. Syst. Nat. 12th ed. 1: 99. (species based on the domesticated breed).

1811. Bos poëphagus Pallas. Zoogr. Ross. Asiat. 1: 248. pl. 22. (renaming of grunniens).

1827. Bos (Bison) poëphagus H. Smith. Griffith's Cuvier Animal Kingd. Vol. 5, p. 374.

1833. Poëphagus grunniens Gray. List Mamm. B. M. p. 153.

Type locality: Tibet.

1891. Bos (Poëphagus) grunniens Huet. Bull. Soc. Acclim. Paris 38: 334.

1898. Bos (Bison) grunniens Lydekker. Wild Oxen, Sheep, and Goats. p. 51, pl. 4.

Type locality: Tibet.

Distribution: Tibetan Plateau, Kansu, Chang-Chenmo Region of Jammu-Kashmir, Dolpa and Mustang Districts of Nepal, Sikkim and Bhutan.

Nepal Records: Hinton and Fry (1923, p. 424).

NEP: 1 skull: Mitchell - 1.

Habitat: Desolate mountains and the alpine steppe biotope of the Dolpa and Mustang Districts; 4200 to 6000 m.

Discussion: The wild yak is massive in build with short, stout limbs. The withers form a conspicuous hump. The muzzle and ears are relatively small. The large, black horns curve upward and forward in males and measure 650 to

780 mm in length. The horns of a single specimen from Mustang measured 774 mm in length. Long mats of hair fringe the lower parts of the shoulders, sides, flanks and thighs. The long, bushy tail drags on the ground. Wild yaks are blackish brown in color and old bulls are reddish on the back. Females have two pairs of teats. According to Walker et al. (1964b), the wild yak bull is nearly twice as large as the domesticated variety. It stands 2 m at the shoulder and weighs 500 to 550 kg.

Wild yaks are found only at high altitudes in the mountainous regions of the Dolpa and Mustang Districts. They cannot survive in the lower, warmer areas of these regions. They feed on grass, moss, lichens and small shrubs. Yaks are called "grunting ox" because of their deep guttural grunt. When irritated, they grunt and swish their tails vigorously. Domesticated yak bulls are allowed to run wild while the cows are milked and sheared for their wool.

Observations of domesticated animals suggest that mating takes place in October and November and one calf (rarely two) is born the following April or May. The gestation period is about 10 months. Domesticated yaks interbreed freely with local cattle.

Hinton and Fry (1923) and Hodgson (in Gray 1846) stated that this species inhabits the northern regions of Nepal, but they cited no specimens from the area. In March,

1970, my assistant obtained a massive skull of an old bull that had been shot supposedly near Mustang, Mustang District. Natives have reported sighting herds of wild yaks near Dolpa, Dolpa District.

ECTOPARASITES

Ixodoidea:	Haemaphysalis aponommoides H. nepalensis Ixodes acutitarsus I. lindbergi (="ovatus")
Mallophaga:	Bovicola bovis
Anoplura:	Linognathus vituli

Bubalus bubalis bubalis (Linnaeus, 1758)

Indian Buffalo, Water Buffalo, Arna

1758. Bos bubalis Linnaeus. Syst. Nat. 10th ed. 1. p. 72. (Linnaeus' description was based on a domesticated form.)

Type locality: Rome, Italy.

1788. Bos bubalus Gmelin. Syst. Nat. 1: 206.

Type locality: Asia.

1792. Bos arnee Kerr. Animal Kingd. p. 336.

Type locality: India, north from Bengal.

1821. Bos buffelus Blumenbach. Handb. Naturges. 10: 119.

Type locality: Asia.

1827. Bos arni H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 388.

Type locality: Central Bengal.

1836. Bubalus arnee Jardine. Nat. Libr., Mamm. 4: 243.

1841. Bubalus arna Hodgson. J. Asiat. Soc. Bengal 10(1): 469.

1842. Bubalus arna var. macrocerus Hodgson. J. Asiat. Soc. Bengal 10(2): 912. (nom. nud.)

Type locality: Assam.

1842. Bubalus arna var. speirocerus Hodgson. J. Asiat. Soc. Bengal 10(2): 912. (nom. nud.)

1846. Bubalus buffelus Gray. Hodgson's Coll. B. M. p. 25.

1865. Buffelus indicus Rutimeyer. Verh. Naturf. Ges. Basel 4: 334.

Type locality: India.

1867. Bubalus arni Jerdon. The Mamm. of India. p. 307.

1867. Bos (Bubalus) buffelus Blanford. J. Asiat. Soc. Bengal 36: 195.

1898. Bos (Bubalus) bubalis Lydekker. Wild Oxen, Sheep and Goats. p. 118, pl. 9.

1912. Bubalus bubalis (Linnaeus), in Hollister. Phillip J. Sci. 7: 45.

Distribution: Peninsular India, eastern Terai of Nepal, Cooch Bihar, Bhutan Duars, Assam, Burma.

Nepal Records: Hinton and Fry (1923, p. 424), Chesemore (1970, p. 166).

Habitat: The swampy region of the Sapt Kosi River flood plain.

Discussion: Hodgson (1841e) described two varieties of water buffalo on the basis of the horns: macrocerus with very long, nearly straight, well thrown-back horns;

and speirocerus with horns much shorter, well curved and more directed forward. Lydekker (1913) treated macrocerus as a subspecies and listed its type locality as Assam. Hinton and Fry (1923) agreed to the taxonomic position of macrocerus but differed on the type locality, which they recorded as Nepal.

Lydekker (1913) preferred to treat Bubalus as a subgenus of Bos, but Simpson (1945) elevated it to generic rank, a position to which Ellerman and Morrison-Scott (1966) agree.

The water buffalo is heavily built with the contour of the back nearly straight. The face is long and narrow, the ears are large and the muzzle is broad. The short limbs are stout, and the tail is tufted, reaching about to the hocks. The hooves are large and splayed. The hair is moderately long, coarse and sparse. There is a tuft of hair on the forehead. The horns are more or less triangular for the greater part of their length and are situated low on the skull. The spread of the horns in old bulls may approach 3 m and in cows 2.1 m. The head and body length is 2.5 to 3 m, the tail length 0.6 to 1 m, the shoulder height 1.5 to 1.8 m and the weight 700 to 900 kg.

Indian buffaloes inhabit the many islands, sand bars and swamps of the Sapt Kosi River flood plain, which are overgrown with tall grasses and reeds. They are gregarious, assembling in herds of up to 50 animals. They feed during

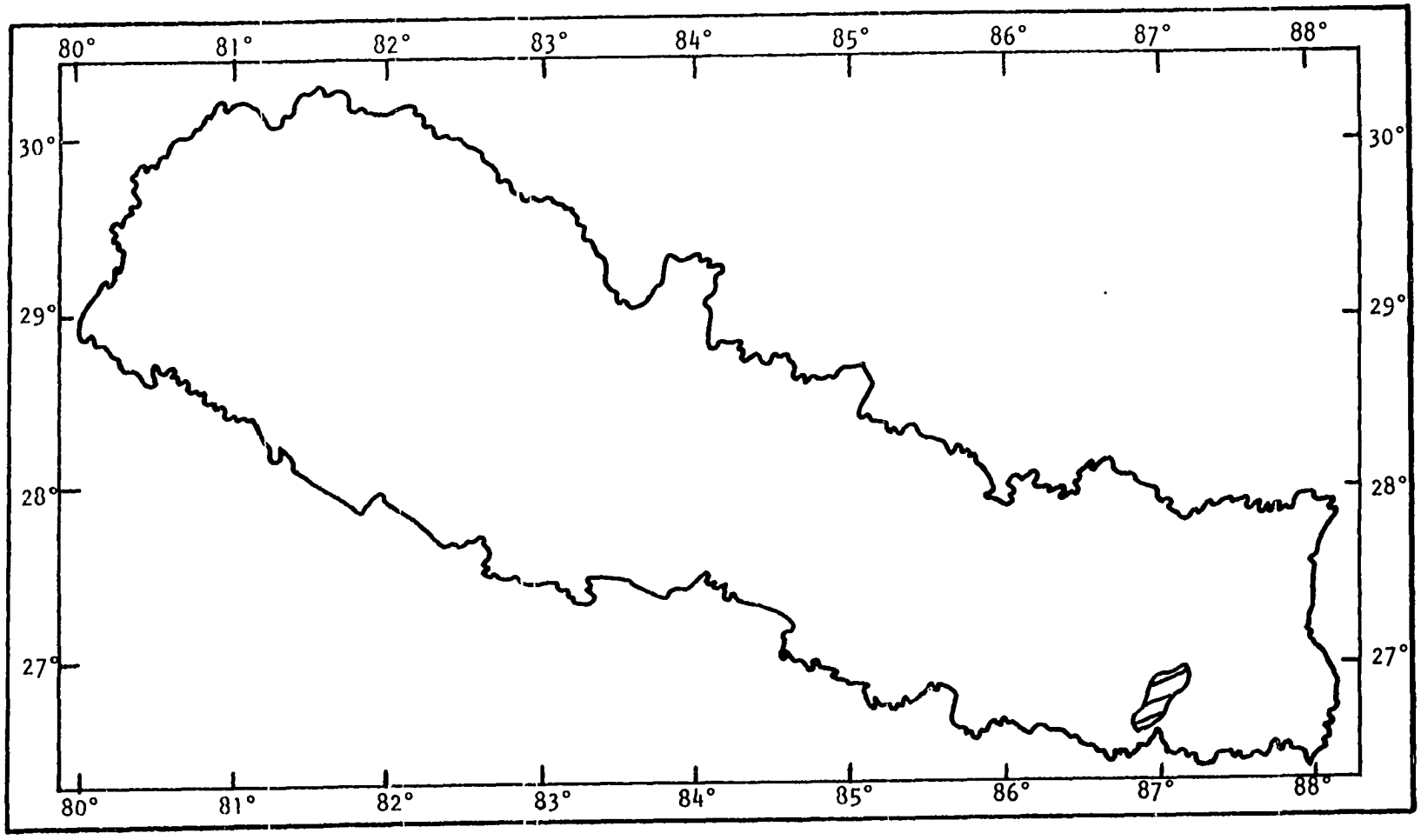


Fig. 77. Approximate distribution for Bubalus bubalis

the morning and evening, spending the heat of the day in mud wallows or water holes. Their food consists strictly of grass. They mate near the end of the monsoons (September) and the gestation period is approximately 10 months. Usually two calves are born in summer (June or July). The number of wild water buffaloes estimated to be left in Nepal is 100 to 150.

Antilope cervicapra cervicapra (Linnaeus, 1758)

Blackbuck Antelope

1758. Capra cervicapra Linnaeus. Syst. Nat. 10th ed. 1. p. 69.

Type locality: Travancore, India.

1767. Antilope cervicapra Pallas. Spic. Zool. 1: 19, pls. I and II.

Type locality: India.

1816. Cemas strepsiceros Oken. Lehrb. Naturgesch. 3(2): 732.

Type locality: India.

1843. Cervicapra bezoartica Gray. List Mamm. B. M. p. 159.

Type locality: India.

1867. Antilope bezoartica Jerdon. The Mamm. of India. p. 275.

Distribution: The Gangetic plain of India, western Terai of Nepal.

Nepal Records: Hodgson (1834b, p. 99), Gray (1846, p. 27), Hinton and Fry (1923, p. 426), Chesemore (1970, p. 166).

NEP: 2 specimens: Mitchell - 2.

Habitat: Open plains, short grass lands and cultivated areas of the western Terai.

Field Notes: The blackbuck is a gracefully built, medium sized antelope. Males have horns that twist in a heteronomous, corkscrew-like spiral and may reach 650 mm in length. The muzzle is narrow and the tail is moderately short. Large face glands and inguinal glands are present. Blackbucks are one of the few antelopes in which the coloration of males differs from that of females. Does and young bucks are yellowish fawn on the back and on the outside of the limbs; the lower parts are white. These two colors are sharply delineated. Bucks are blackish brown or black except on the nape, which is rufous brown, while the sides of the neck and face are blackish brown except for a white area around each eye. The underparts are white. A single pair of mammae is present. The head and body length is about 1.2 m, the tail length 150 to 180 mm and the shoulder height 700 to 800 mm. Bucks weigh about 40 kg while females average 30 kg.

Blackbucks inhabit open plains, avoiding heavy jungles or hilly terrain. They are somewhat nocturnal, spending the heat of the day in dense thickets of Acacia. Usually they are found in herds of 20 to 30, although there are reports from India that several hundred gather together

at one time. When alarmed, these antelope spring into the air. First one of the herd leaps in the air, then all the other members follow, one after another. Their diet consists of grasses, cereal grains and fruit. They are fond of the fruit of the mauwa tree (Engelhardtia spicata).

Blackbucks are supposed to mate during February or March (Blanford 1891; Prater 1965). Walker et al. (1964b) reported a gestation period of approximately 180 days. Field data collected by the NEP suggest that they breed in May and June with one to two fawns being born in November or December. In April, 1968, does with young fawns (about four months old) were sighted near Bahwanipur, Banke District.

Blackbucks are rare in Nepal and are found only in the southwestern Terai (Banke, Bardia, Kailali and Kanchanpur Districts). The Banke District Forest Officer estimated in 1968 that as few as 100 to 150 animals remain in the entire country. Blackbucks were sighted on several different occasions near Bahwanipur, Banke District. On 9 March, 1968, a herd of females with young and a few young bucks was seen feeding on fruit from the mauwa tree.

ECTOPARASITES

Siphonaptera:	Ancistropsylla nepalensis Ctenocephalides felis orientis
Ixodoidea:	Dermacentor auratus Haemaphysalis bispinosa

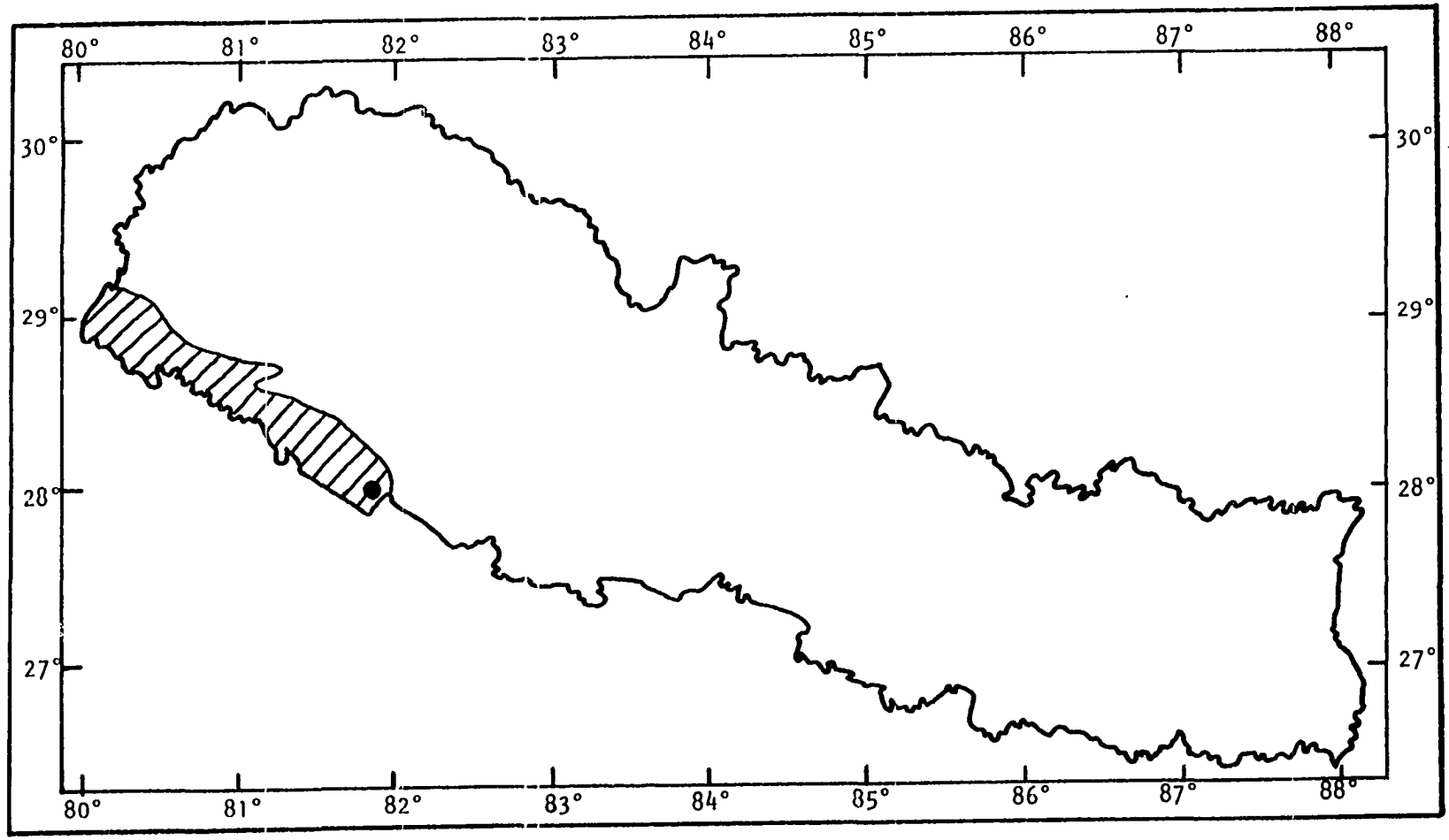


Fig. 78. Collection site and approximate distribution for Antilope cervicapra

H. himalaya
Hyalomma sp.
Rhipicephalus haemaphysaloides

Diptera: Lipoptena axis

Capricornis sumatraensis thar (Hodgson, 1831)

Serow

1831. Antilope thar Hodgson. Gleanings Science 3: 324.

Type locality: Nepal Himalaya.

1832. Antilope bubalina Hodgson. Proc. Zool. Soc. London. p. 12.

Type locality: Nepal.

1834. Antilope (Nemorhedus) thar Hodgson. Proc. Zool. Soc. London. p. 86.

Type locality: Nepal.

1836. Capricornis thar Ogilby. Proc. Zool. Soc. London. p. 138.

1842. Nemorhaedus vel Kemas proclivus vel thar Hodgson. J. Asiat. Soc. Bengal 10: 913. (nom. nud.)

1843. Capricornis bubalina Gray. List. Mamm. B. M. p. 116.

Type locality: Nepal.

1867. Nemorhaedus bubalina Jerdon. The Mamm. of India. p. 283.

1891. Nemorhaedus bubalinus Blanford. The Fauna Brit. India, Mamm. p. 513.

1900. Nemorhaedus sumatrensis bubalinus Lydekker. Great and Small Game of India. p. 128.

Type locality: Nepal Himalaya.

1908. Capricornis sumatraensis thar (Hodgson), in Pocock. Proc. Zool. Soc. London. p. 176.

1916. Capricornis sumatrensis bubalinus Lydekker. Cat. Hume's Bequest B. M. p. 23.

Type locality: Nepal Himalaya.

1966. Capricornis sumatraensis thar (Hodgson), in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 399.

Distribution: Garhwal, Kumaon, Nepal, Darjeeling, Sikkim, Mishmi Hills, Garo Hills, Assam.

Nepal Records: Hodgson (1831a, p. 324; 1832b, p. 12; 1834a, p. 86), Gray (1843, p. 116), Pocock (1908, p. 176), Hinton and Fry (1923, p. 425), Caughley (1969, p. 6).

NEP: 5 specimens: Mitchell - 3; AVWE - 2.

Habitat: Densely thicketed ravines, bamboo thickets and rocky outcroppings in the midlands; 900 to 3500 m.

Taxonomic Notes: Blanford (1891) reported two species of serows from the Himalayas: Nemorhaedus bubalinus, the Indian goat-antelope, and N. sumatraensis, the Burmese goat-antelope. Lydekker (1900) treated the two as local races and combined them with the Sumatran species, Capricornis sumatraensis. Pocock (1908) shared this view, reporting the Himalayan serow as Capricornis sumatraensis thar.

Field Notes: The serow is rather lanky in build with long, pointed ears, a dorsal crest or mane on the neck and a short tail. Horns are present in both sexes and are marked with narrow transverse rings. Large suborbital glands are present and the rhinarium is naked. The coat is black or

gray above and somewhat grizzled because the pelage is whitish at the base. The head and neck are black, fading into rusty red on the shoulders, flanks and lower thighs. The inside of the limbs and belly is dirty gray. There is a varying amount of white on the muzzle, throat and chest. There are two pairs of inguinal mammae. The length of the head and body is 1200 to 1500 mm, the tail length 80 to 120 mm, the shoulder height 800 to 900 mm and the weight 80 to 110 kg.

Serows frequent steep, rocky outcroppings and cliffs, resting in caves beneath overhanging rocks. Males are generally solitary with immatures banding together in herds of 5 to 15. They feed in early morning and late evening; their diet consists of shrubs, grasses and mosses. They often emerge from dense bamboo thickets to sun themselves on large rocks. They repeatedly use the same area to defecate and large heaps of droppings 200 to 300 mm deep have been found in bamboo thickets and beneath overhanging rocks.

Little is known about their breeding habits. In Burma, one to two young are born in either September or October after a gestation period of about eight months (Walker et al. 1964b). According to Prater (1965), mating begins at the end of October in the Himalayas and young are born the following May or June. He reported a gestation period of about seven months.

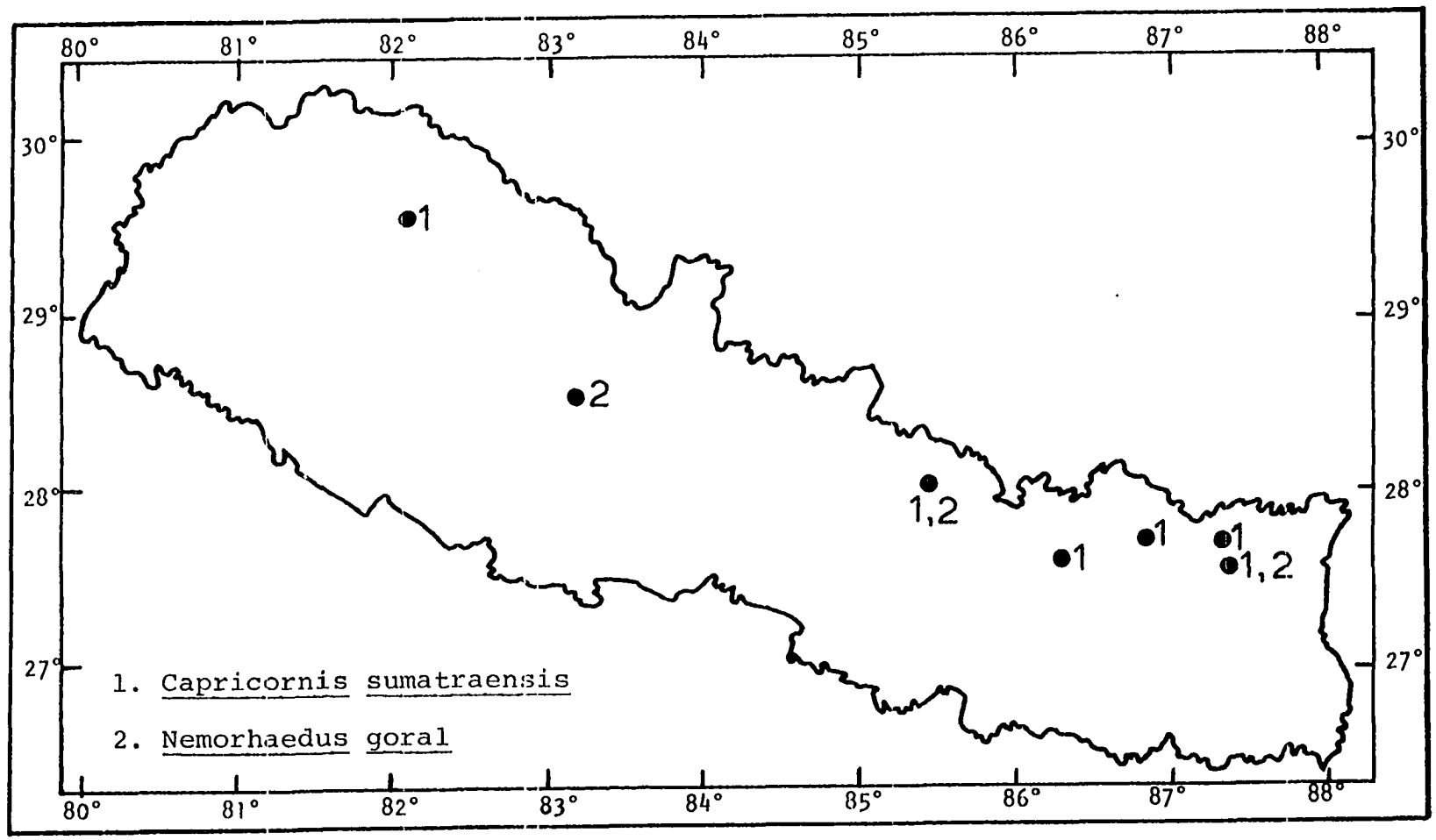


Fig. 79. Collection sites and sightings for subfamily Caprinae

ECTOPARASITES

Ixodoidea:	*Haemaphysalis aponommoides* *H. montgomeryi* *H. nepalensis* *Ixodes acutitarsus* *I. lindbergi* (="*ovatus*") *I.* sp.
Diptera:	*Lipoptena weidneri*
Mallophaga:	*Bovicola hemitragi* *B. thompsoni*

Nemorhaedus goral goral (Hardwicke, 1825)

Gray Himalayan Goral

1825. *Antilope goral* Hardwicke. Trans. Linn. Soc. London 14: 518.

Type locality: Nepal Himalaya.

1827. *Antilope duvaucellii* H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 279.

1834. *Antilope* (*Nemorhedus*) *goral* Hodgson. Proc. Zool. Soc. London. p. 85.

1836. *Kemas goral* Ogilby. Proc. Zool. Soc. London. p. 138.

1846. *Naemorhedus goural* Gray. Cat. Hodgson's Coll. B. M. p. 26.

1884. *Nemorhaedus goral* (Hardwicke), *in* Flower and Garson. Cat. Osteol. Mus. R. Coll. Surg. 2: 258.

1891. *Cemas goral* Blanford. The Fauna Brit. India, Mamm. p. 516.

1900. *Urotragus goral* Lydekker. Great and Small Game of India. p. 136.

Type locality: Himalayas.

1905. Urotragus bedfordi Lydekker. Zoologist 9: 83.

Type locality: Dharmsala, Himalayas (Lydekker, 1913).

1908. Naemorhedus goral (Hardwicke), in Pocock. Proc. Zool. Soc. London. p. 192.

Nemorhaedus goral hodgsoni Pocock, 1908

Brown Himalayan Goral

1908. Naemorhedus hodgsoni Pocock. Proc. Zool. Soc. London. p. 195.

Type locality: Sikkim.

1913. Nemorhaedus hodgsoni Lydekker. Cat. Hume Bequest. B. M. p. 26 (respelling of Naemorhedus).

1966. Nemorhaedus goral hodgsoni (Pocock), in Ellerman and Morrison-Scott. Checklist of Palaearctic and Indian Mamm. 2nd ed. p. 402.

Distribution: Kashmir, Punjab, Kumaon, Nepal, Sikkim.

Nepal Records: Hardwicke (1825, p. 518), Hodgson (1834a, p. 85), Gray (1846, p. 26), Hinton and Fry (1923, p. 425), Fry (1925, p. 530), Caughley (1969, p. 5), Chesemore (1970, p. 166).

NEP: 6 specimens: Mitchell - 4; AVWE - 2.

Habitat: Rugged grassy outcroppings and rocky cliffs near forests in the Mahabharats and midlands, 1000 to 2500 m.

Taxonomic Notes: Pocock (1908) and Lydekker (1913) recognized two species of gorals from the Nepal Himalayas, Nemorhaedus goral Hardwicke, 1825, and N. hodgsoni Pocock, 1908. Ellerman and Morrison-Scott (1966) treated them as

subspecies of Nemorhaedus goral. Pocock (1908) separated N. hodgsoni from N. goral because the general color of N. hodgsoni is brown with a black dorsal stripe extending at least to the loins. There is also a black stripe on the dorsal surface of the tail and another along the back of each thigh. Nemorhaedus goral is gray to fawn gray, lacking the dorsal stripe and the black stripe on the back of the thigh. According to Pocock (1913), N. g. goral is found in Kashmir and the western Himalayas, while N. g. hodgsoni is located in Nepal and Sikkim.

Both color phases of gorals have been sighted in Nepal. Whether the color differences are due to age, sex or seasonal variation or these two gorals are truly separate subspecies, it is impossible to determine.

Field Notes: The goral resembles the serow in appearance, but the goral is distinguished by its smaller size, absence of facial glands and shorter horns. It is goat-like in appearance with stout limbs. The body is covered by a short, wooly undercoat, which is protected by long, coarse guard hairs. Males have a short, semi-erectile mane on the neck. Short horns (100 to 140 mm) present in both sexes are directed backward and slightly downward. The color is a darkish golden brown speckled with black to gray or fawn gray. There is a white patch on the throat and a black tip on the tail. The number of mammae is four. The head and body

length is 850 to 1200 mm, the tail length 100 to 175 mm, the shoulder height 500 to 700 mm and the weight 20 to 30 kg.

Gorals inhabit rocky outcroppings and steep grassy slopes in the middle Himalayas. Some authors (Blanford 1891; Walker et al. 1964b; Prater 1965) report that they associate in small family groups of four to eight. All gorals sighted in Nepal were either solitary animals or females with a single kid; large groups were never encountered. They feed in early morning and late evening, spending the day bedded down on nearly inaccessible rocky ledges. The diet consists of forbs, grasses and mosses. When frightened they utter a whistling snort.

Walker et al. (1964b) reported a gestation period of about six months, with usually a single kid born during May or June. A female taken in May was lactating and another female was sighted in August with a one-third grown kid. Young are probably born during March in the Nepal midlands.

ECTOPARASITES

Ixodoidea:	Haemaphysalis aponommoides
	H. birmaniae
	H. himalaya
	H. nepalensis
	H. warburtoni
	Ixodes acutitarsus
	I. nuttallianus
	I. lindbergi (="ovatus")
	Rhipicephalus haemaphysaloides
Diptera:	Lipoptena weidneri

Mallophaga: Bovicola dimorpha

Hemitragus jemlahicus jemlahicus (H. Smith, 1826)

Himalayan Tahr (or Thar), Jharal

1826. Capra jemlanica (jemlahica on plate) H. Smith. Griffith's Cuvier Animal Kingd. Vol. 4, p. 308.

Type locality: Jemla Hills, Nepal, (probably Jumla Hills).

1827. Capra jemlahica H. Smith. Griffith's Cuvier Animal Kingd. Vol. 5, p. 358.

Type locality: Jemla Hills, Nepal.

1833. Capra jharal Hodgson. Asiatic Res. 18(2): 129.

Type locality: Nepal.

1836. Capra quadrimammis Hodgson. J. Asiat. Soc. Bengal 4: 710.

Type locality: Nepal.

1841. Hemitragus quadrimammis var. jharal Hodgson. J. Asiat. Soc. Bengal 10: 913.

Type locality: Nepal.

1846. Hemitragus jemlaica Gray. Cat. Hodgson's Coll. B. M. p. 28.

1867. Hemitragus jemlaicus Jerdon. The Mamm. of India. p. 286.

1913. Hemitragus jemlahicus (H. Smith), in Lydekker. Cat. of Ungulates. Vol. 1, p. 172.

Distribution: The Himalayas, from Pir Panjal Mountains, Kashmir, Punjab, Kumaon, Nepal to Sikkim.

Nepal Records: Hodgson (1833a, p. 129; 1835a, p. 490;

1841e, p. 913), Gray (1846, p. 28), Hinton and Fry (1923, p. 425), Biswas and Khajuria (1957, p. 239), Caughley (1969, p. 6), Schaller (1973, p. 1).

NEP: 4 specimens: Mitchell - 4.

Habitat: Precipitous terrain of the midlands and inner Himalayas; from dense broadleaved forests to steep, alpine mountain slopes; 2000 to 4500 m.

The tahr resembles the true goat (Capra), but differs in that both sexes lack a beard, both sexes have short, laterally compressed horns (300 to 400 mm in length) which curve backward, and females have four mammae instead of two (Lydekker 1913). The tahr has a heavy body, long robust limbs and a long, narrow face. A shaggy mane around the nape and shoulders extends to the knees. The underside of the tail is bare; the knees and chest have callous pads. The color of the back is a rich reddish or dark brown. The mane is often lighter, a honey brown, while the face and the front of the legs are dark or blackish brown. The head and body length is 1200 to 1400 mm, the tail length 80 to 120 mm, the shoulder height 800 to 1100 mm and the weight 75 to 100 kg.

There are conflicting reports concerning the habitat preferences of tahr. Lydekker (1913) gave their distribution as the forest districts in the middle ranges of the Himalayas. Prater (1965) stated that they are never found above tree-line. Blanford (1891) quoted Kinlock in saying that "the tahr is a forest-loving animal, and although it sometimes

resorts to the rocky summits of the hills, it generally prefers the steep slopes which are more or less clothed with trees." Caughley (1969) found that tahr prefer subalpine regions between 3900 and 5300 m and Schaller (1973) reported that they spent much of their time above timber line during summer and autumn.

During the NEP project, several bands of tahr were observed, all above treeline. Only once did they descend into the forest and that was when hunters were in pursuit. In the Langtang Valley, Rasuwa District, tahr inhabited steep, rocky cliffs broken by ledges which supported clumps of grasses and shrubs. In the Gosainkund Lekh, tahr were found 1300 to 1500 m above treeline.

Gregarious, tahr travel in herds of 15 to 30. They are wary and difficult to approach, especially from below. Their principal food is grass, supplemented with browse. According to Schaller (1973), females produce their first young at the age of three. Mating takes place between October and January. The gestation period is approximately six and one-half months and young are born during May and June. Usually a single young is born, but twins are not uncommon.

In November of 1969, a band of females with one-third grown kids was sighted above Thare Pati (4500 m). The kids probably had been born during May or June of that year.

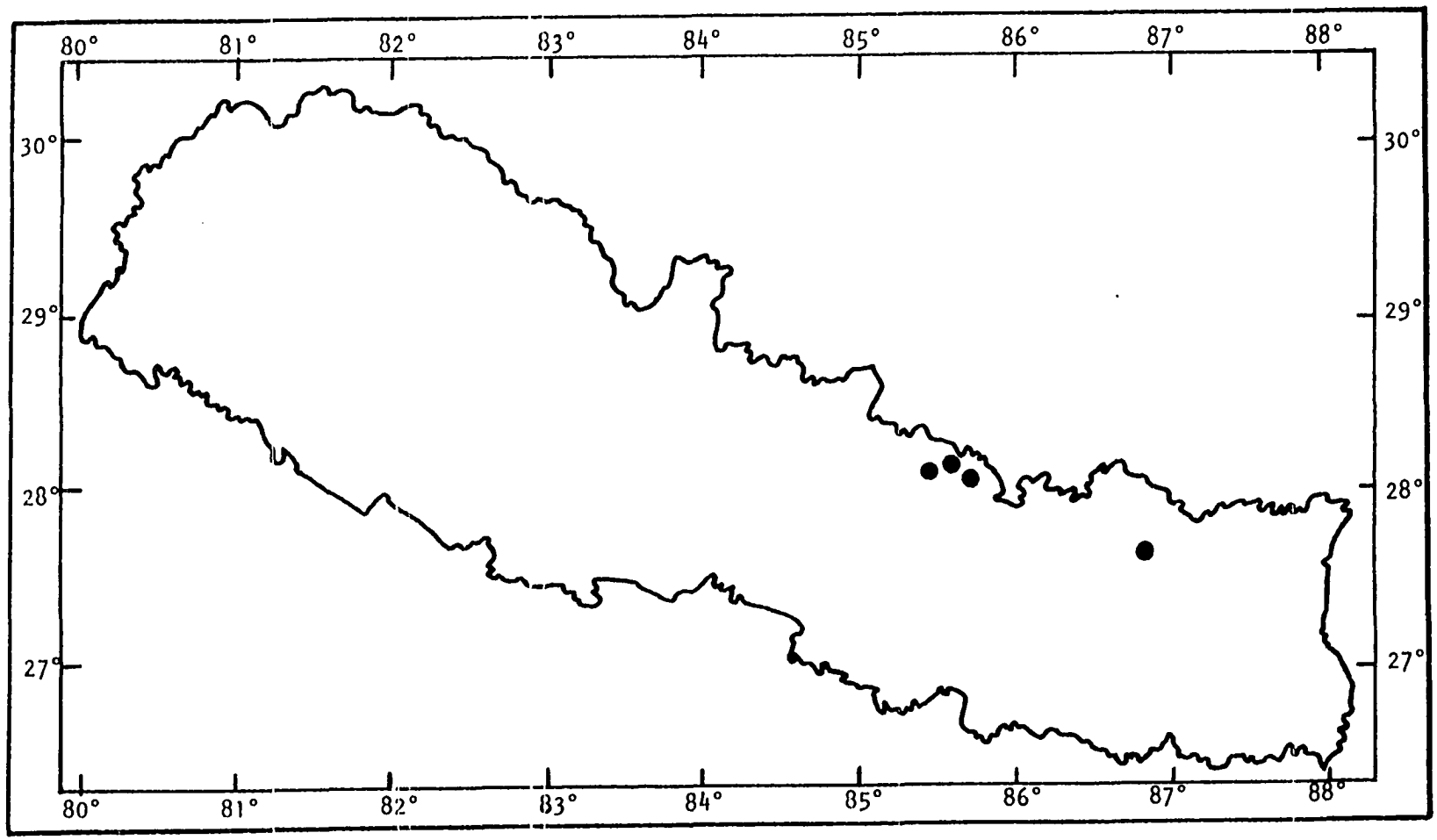


Fig. 80. Collection sites for Hemitragus jemlahicus

ECTOPARASITES

Ixodoidea: *Haemaphysalis warburtoni*

Mallophaga: *Bovicola hemitragi*

Anoplura: *Haemodipsus lyriocephalus*

Pseudois nayaur nayaur (Hodgson, 1833)

Bharal, Blue Sheep

1833. *Ovis nayaur* Hodgson. Asiat. Res. 18(2): 135.

Type locality: Tibetan frontier of Nepal.

1835. *Ovis nahcor* Hodgson. Proc. Zool. Soc. London. 1834, p. 107.

Type locality: Kachar region of Nepal.

1841. *Ovis burrhel* Blyth. Proc. Zool. Soc. London. 1840, p. 67.

Type locality: Boorendo Pass, Tibet.

1843. *Ovis nahura* Gray. List. Mamm. B. M. p. 170.

Type locality: Nepal.

1846. *Ovis barhal* Hodgson. J. Asiat. Soc. Bengal 15: 342.

1863. *Ovis burhel* Gray. Cat. Hodgson's Coll. B. M. 2nd ed. p. 13.

Type locality: Nepal.

1898. *Ovis (Pseudois) nahura* Lydekker. Wild Oxen, Sheep and Goats. p. 231.

Type locality: Tibetan frontier of Nepal.

1910. *Pseudois nayaur* (Hodgson), *in* Pocock. Proc. Zool. Soc. London. p. 863.

1912. Pseudois nahura Lydekker. The Sheep and its Cousins. p. 305.

Distribution: The Himalayas; Bhutan, Sikkim, Nepal to Kashmir, Tibet.

Nepal Records: Hodgson (1833a, p. 135; 1834c, p. 107; 1846, p. 343), Gray (1843, p. 117; 1863b, p. 13), Lydekker (1898, p. 231), Hinton and Fry (1923, p. 425), Schaller (1972, p. 523).

NEP: 1 specimen; 1 skull: Mitchell - 2.

Habitat: The main Himalayan range from treeline to snowline, grassy alpine slopes near rocky outcroppings and steep cliffs; 3600 to 5000 m.

Field Notes: The bharal is often regarded as an aberrant sheep with goat-like affinities. It is sheep-like in that it lacks a beard and any "goaty" smell, but in nearly every other aspect it resembles the genus Capra. The horns are similar to those of the Caucasian Tur, the tail is longer than in Ovis and facial glands are absent as in Capra (Lydekker 1913). There are two inguinal mammae as in Ovis.

The back and sides are metallic gray or slate gray in color, the underparts white. Males have black markings on the face, chest and sides and a dark stripe down the front of all limbs. Horns, borne by both sexes, are 500 to 800 mm in length. Peculiar in shape, they are rounded and smooth,

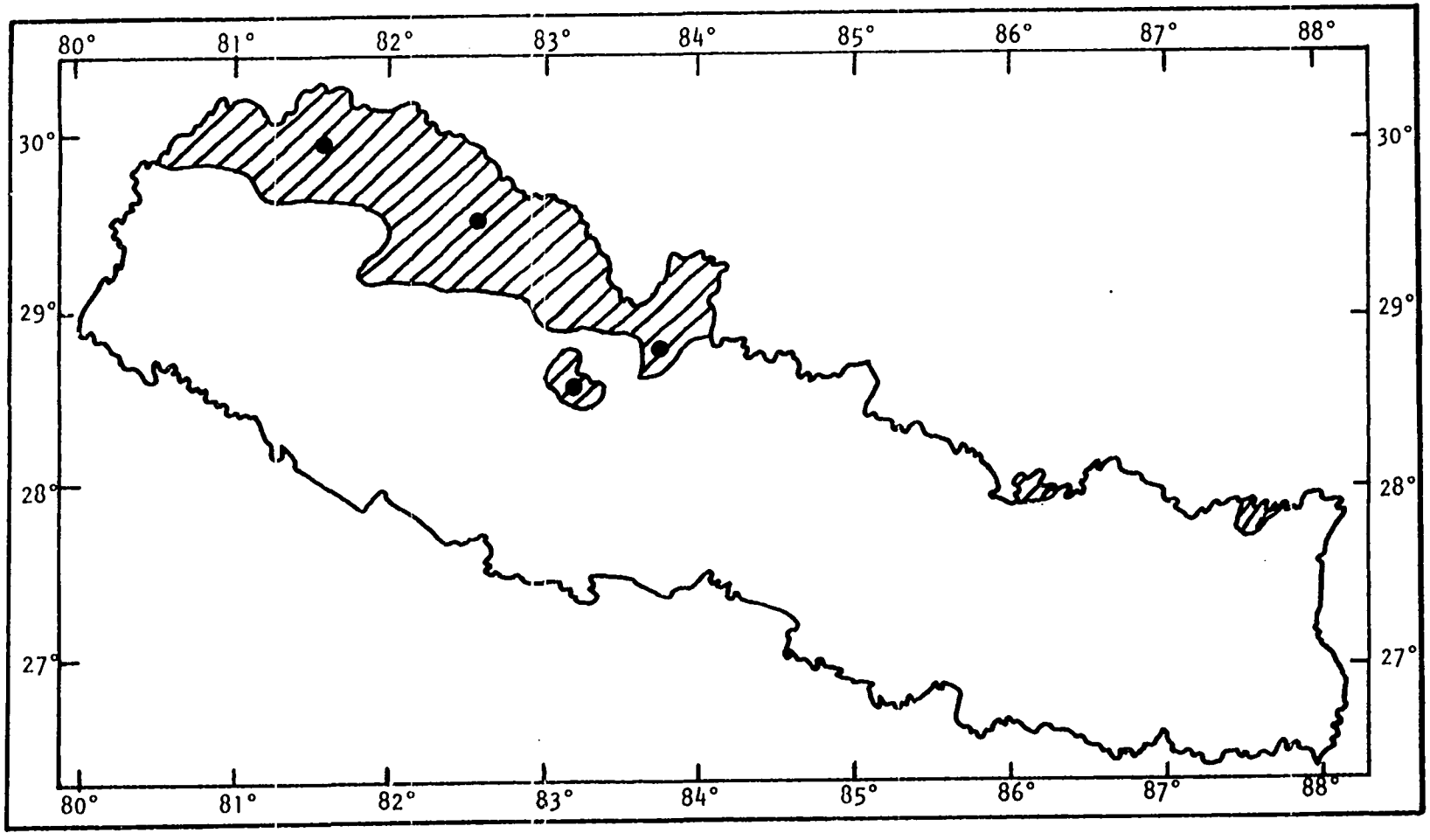


Fig. 81. Sightings and approximate distribution for Pseudois nayaur

curving backward over the neck. The head and body length is 1.2 to 1.4 m, the tail length 150 to 200 mm, the shoulder height 750 to 900 mm and the weight 600 to 75 kg.

Blue sheep inhabit virtually inaccessible areas of the main Himalayan Range, especially the far northwestern region of the country bordering Tibet. A map of the distributional range for these sheep in Nepal is provided by Schaller (1972). They usually occur in herds of 10 to 30, although up to 300 may assemble at times. A band of 37 was sighted near Dhorpatan, Dolpa District, at 5000 m. Herd structure changes with the seasons, males tending to separate from the females after the rut. However, a few young males associate with females throughout the year.

The diet consists of grasses, legumes, forbs, ferns and browse and lichens are part of the winter food. These sheep rut between September and October. After a gestation period of about 160 days, lambs (usually two) are born during April and June (Schaller 1972).

ECTOPARASITES

Ixodoidea: *Dermacentor everestianus*

Ovis ammon hodgsoni Blyth, 1841

Nayan, Great Tibetan Sheep (Hodgson's Big-horn)

1841. *Ovis hodgsonii* Blyth. Proc. Zool. Soc. London. 1840, p. 65.

Type locality: Tibet, probably the northern frontiers of Nepal.

1841. Ovis ammonoides Hodgson. J. Asiat. Soc. Bengal 10(1): 230, pl. 1.

Type locality: Himalayan Region.

1851. Ovis ammon Horsfield. Cat. E. Ind. Mus. p. 171.

1852. Caprovis bembhera Gray. Cat. Mamm. B. M. Vol. 3, p. 174, pl. 16.

Type locality: Nepal.

1858. Caprovis argali Adams. Proc. Zool. Soc. London. p. 527.

Type locality: Border of Ladak.

1873. Ovis blythi Severtzov. Mem. Soc. Amis. Sci. Nat. Moscou 8(2): 154.

Type locality: Tibet.

1874. Ovis brookei Ward. Proc. Zool. Soc. London. p. 143.

Type locality: Ladak (Kashmir).

1892. Ovis henrii Milne-Edwards. Rev. Gen. Sci. Pur. Appl. p. 672.

Type locality: Tibet.

1898. Ovis ammon hodgsoni Blyth, in Lydekker. Wild Oxen, Sheep and Goats. p. 180, pl. 15.

Distribution: Kashmir, northern Nepal, Sikkim, Bhutan, Tibet.

Nepal Records: Hodgson (1834b, p. 99; 1841a, p. 230), Gray (1846, p. 29), Hinton and Fry (1923, p. 427).

Habitat: Bare, undulating Tibetan Plateau of the Mustang District, open, rocky alpine regions of the inner

Himalayas; 3500 to 5500 m.

Discussion: Male nayans have massive spiral horns 1200 to 1450 mm in length, while females have only slightly curved horns a few centimeters in length. It is possible to determine the age by counting growth rings on the horns. One growth ring is laid down for each winter after the first year.

These sheep are large with very short tails. The coat is short, coarse and very close to the body. A large throat ruff is present at all seasons and a crest of hairs, not as long as the throat ruff, extends from the nape to the withers. Facial glands and hoof glands are present. The color is grayish brown above and paler or whitish below. The rump, throat, chest and inner sides of the legs are white. A dark stripe extends down the front of each leg. A single pair of inguinal mammae is present. The head and body length is 1.5 to 1.8 m, the tail length 75 to 100 mm, the shoulder height 1100 to 1200 mm and the weight 115 to 150 kg.

Nayans rarely range south of the main Himalayan axis. They inhabit the bare, undulating Tibetan Plateau from northern Kashmir to the country north of Sikkim. These sheep are migratory in habit, spending the summer months at high elevations (5000 m). In winter they descend to lower valleys (3500 m). During summer, rams are separate from the ewes and lambs. In winter, both sexes band together in

flocks of 15 to 35.

Grasses, flowers, moss, lichens and some browse make up the diet. Mating begins in October and lambs are born the following May or June. Walker et al. (1964b) listed a gestation period of 150 to 180 days after which one to two lambs are born. The life expectancy is about 10 to 15 years.

Reports are that because the Chinese hunt nayans for food, they have migrated into some of the higher valleys of the northern Himalayas along the Nepal-Tibet border. Twice, information was reported to me on the occurrence of these sheep in Nepal. Peter Aufschneider, an Austrian engineer, sighted a band of 15 in April of 1965 above Chum Gompa, Gorkha District. In October of 1968, Captain Singh found the skull of a five year old ram at Goom, Mugu District.

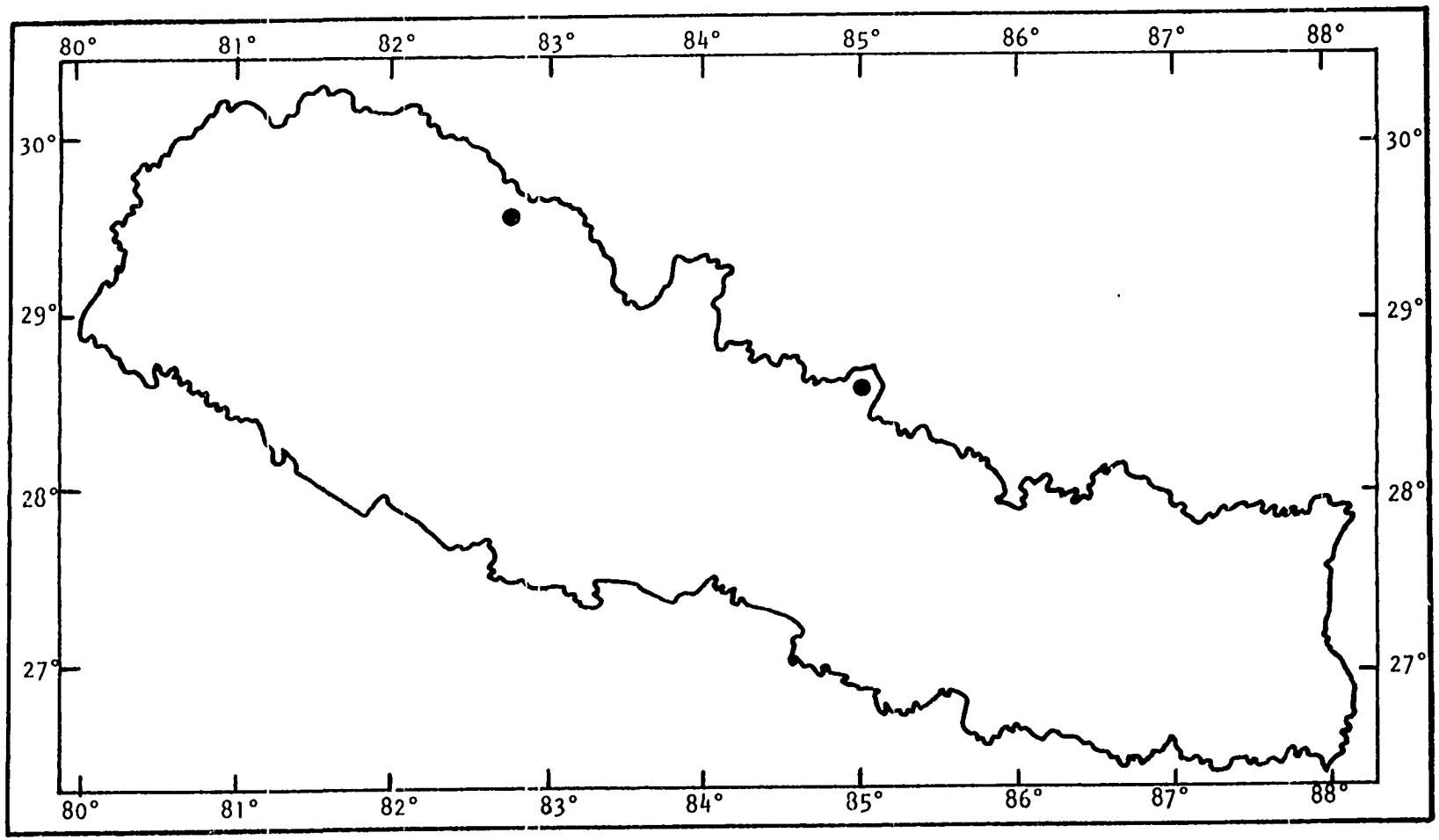


Fig. 82. Sightings for Ovis ammon

RESULTS

Host Preference and Specificity

The Nepal Ectoparasite Program collected a total of 5,192 hosts: 3,695 mammals, 474 birds and 595 farm livestock. There were 225 ectoparasite collections from humans and another 203 from flagging, examination of dung, guano and nesting material.

Approximately 86.7% (3,206) of the mammals collected were infested with ectoparasites. The mammal collections consisted of 91 terrestrial species and 18 species of bats. Individual mammal preference by ectoparasites has already been listed in the 'Accounts of Species' section. Of the 474 birds collected, 80.8% (383) were positive for ectoparasites. Ectoparasites were taken from 11 species of livestock and domestic animals. The exact numbers of livestock examined were not recorded. Human infestations consisted of some human forms of ectoparasites (lice), but mostly ticks accidently attached to clothing or the skin.

An accurate number of ectoparasites collected is still not available although it is in excess of 100,000 specimens. A total of 36,527 ectoparasites have been processed to date: Fleas - 5,906; Ticks - 21,061; Parasitic Diptera - 296; Mites - 3,705; Mallophaga - 3,398; and Anoplura - 2,161. Over 50% of the ectoparasites collected were mites and less than 14% of the mites have been identified. Forty genera and

90 species of fleas were taken from 28.7% (1,855) of all hosts examined. Three new genera, 24 species and one subspecies have been described and an additional 30 or more taxa new to science await description. Host preference was: Mammals - 92% (1,706); birds - 1.7% (32); livestock - 3.6% (67); humans - 0.80% (15); and other - 1.90% (35).

Approximately 21,061 ticks representing 11 genera and 71 species were taken from 1,762 host collections. Ticks infested 27.3% of all hosts examined. The preferred hosts were: mammals - 40.4% (711); birds - 7.4% (131); livestock - 33.9% (597); humans - 11.1% (196) and other - 7.2% (127). Two ticks that accidentally infest man in high numbers are Haemaphysalis aponommoides and Ixodes acutitarsus. Sixty of the 172 H. aponommoides (34.88%) and 82 of the 159 I. acutitarsus collections (51.57%) were taken from humans.

An accurate number for mites taken is still not available although it is considerably in excess of 50,000 specimens. Less than 14% (3,705) have been processed and identified. This includes 39 genera and 85 species taken from 1,831 host collections. Of the 1,831 hosts infected with mites, 99.33% (1,818) were mammals, 0.54% (10) birds and 0.13% (3) other.

Fourteen genera and 21 species of parasitic Diptera were collected from 97 host collections or 1.8% of all hosts examined had parasitic flies: 63 (71.1%) mammals, 19 (19.6%) birds and 9 (9.39%) livestock. Bats (54) were the most

common host followed by large ungulates (15). Pigeons (Columba sp.) and gallinaceous birds were the preferred avian hosts. Parasitic Diptera were also taken from sheep and dogs. There is a questionable record of Phthona leptoptera taken from Soriculus nigrescens.

Fifty genera and 126 species of Mallophaga, consisting of 3,398 specimens, were taken from 430 host collections. Mallophaga were present on 6.67% of all hosts examined. Of the 430 hosts positive for Mallophaga: 33 (7.7%) were from mammals, 30 (7.0%) from livestock and 367 (85.3%) from birds. A total of 474 birds were examined and 77.4% (367) had chewing lice.

Mallophaga are chiefly parasites of birds with the exceptions of the families Trichodectidae, Gyropidae and Boopidae which are ectoparasites of mammals. Bovicola sp. were taken from goat-antelopes and livestock, Felicola rohani from Herpestes sp., Heterodoxus spiniger from dogs and sheep, Strachiella mustelae from mustelids and Trichodectes sp. from canids.

The exact numbers of Anoplura identified are still unavailable, but 2,161 specimens were taken from 478 host collections. Approximately 7.4% of all hosts examined had sucking lice; 13 genera and 47 species were collected. Anoplura were procured from 397 (83%) mammals, 6 (1.3%) birds, 54 (11.3%) livestock and 21 (4.4%) humans.

The sucking lice taken from livestock belonged to the family Haematopinidae and those from humans, the family Pediculidae. Since Anoplura are strictly mammal ectoparasites, those taken from birds (6 collections) represent errors in recording.

Host Specificity of Ectoparasites (70% Criterion)

Host specificity of ectoparasites by a 70% criterion was numerically analyzed by computer. The 70% criterion is the level of affinity or phenon employed by Sokal and Sneath (1963). Phenons are purely arbitrary and relative groups. A 75 or 80% criterion or phenon could have been selected, but it was felt that if a parasite occurred 70% of the time on a particular host, it showed a high degree of specificity. A 70% criterion also allows for discrepancies in recording and accidental infestations by ectoparasites. The ectoparasite, the host and the number examined (n) and the percentage of occurrence on a particular host are listed in Appendix II.

Mallophaga showed the highest degree of host specificity. Eighty-four out of 126 species were host specific by the 70% criterion. Approximately 28.8% of the fleas, 18.3% of the ticks, 61.9% of the parasitic Diptera, 35.2% of the mites and 61.7% of the Anoplura met the above criterion. Many species of ectoparasites were 100% host specific. This high degree of specificity was due to the collection of a single or a limited number of ectoparasites from a given host species.

Total Numbers of Ectoparasites Collected

The total number of ectoparasites processed is presented in Appendix III. Each species of ectoparasite, the number collected, the percentage each ectoparasite was taken for its group and the percentage it represented of all ectoparasites collected are listed.

Of all the ectoparasites identified and processed 16.17% were fleas, 57.63% ticks, 0.81% parasitic Diptera, 10.14% mites, 9.30% Mallophaga and 5.92% Anoplura. Boophilus microplus was the most frequently encountered ectoparasite. A total of 4,875 specimens, representing 13.35% of all ectoparasites collected, was taken.

Mammals Collected from Each Life Zone

A listing of all mammals collected from each life zone, the number collected, the percentage that was taken from a particular life zone and the percentage of occurrence for all life zones are presented in Appendix IV. The most frequently collected mammals were Mus musculus urbanus (540 specimens or 14.61% of all mammals collected), and M. m. homourus (531 specimens or 14.37% of all mammals collected). These two species of rodents represent approximately 29% of all mammals taken.

Host Affinity Between Geographic Realms and Life Zones

Cluster techniques (Sokal and Sneath 1963; Sneath and

Sokal 1973) were employed to compute the similarity of mammals between the geographic realms and life zones. The results of cluster analysis are presented in dendrograms and data matrices which are representations of the degree of similarity or affinity.

One hundred and thirty species of terrestrial mammals and 619 species of birds were analyzed according to their respective geographic realms of origin. The results are expressed in percentages. Of the 130 mammal species, 26.9% (35) are Palaearctic, 2.3% (3) Ethiopian, 1.5% (2) Holarctic and 69.2% (90) Oriental in origin. For the 619 species of birds, 24.2% (150) are Palaearctic, 1.8% (11) Ethiopian, 1.8% (11) Holarctic and 72.3% (447) Oriental in origin.

The 130 mammal species were clustered according to the life zones in which they were collected. Due to their migratory habits, it was difficult to obtain a true affinity for birds for a particular life zone. Therefore, these data were omitted. The results for the clustering of mammals are presented in Figs. 83 and 84. Figure 83 represents a data matrix illustrating the mammal affinity between life zones. Little difference was found between the mammal fauna of the east and west Terai (84% similarity) and the east and west midlands (85% similarity). The Mahabharat Lekh and Siwalik life zones exhibited the highest degree of affinity (94%). The duns showed a +78% faunal affinity with the east and west

Life Zones	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Terai-west (1)								
Terai-east (2)	84							
Siwaliks (3)	77	78						
Mahabharat Lekh (4)	72	77	94					
Duns (5)	81	80	80	73				
Midlands-west (6)	53	56	71	75	63			
Midlands-east (7)	40	49	58	64	50	85		
Inner Himalayas (8)	53	56	72	72	63	75	76	
Tibetan Plateau (9)	50	53	59	55	42	72	72	86

Mammal Affinity

Fig. 83. Data matrix showing the mammal affinity between life zones

Terai, the Siwalik and the Mahabharet Lekh life zones. This could be expected since there is little difference in the climate, vegetation and elevation between these zones.

The two life zones showing the least mammal affinity are the east midlands and west Terai (40% similarity). The contributing factor could be the difference in rainfall. The east midlands receive up to 3200 mm of precipitation annually and the vegetation consists of subtropical, semi-evergreen forests and temperate, humid evergreen forests. The west Terai receives less than 800 mm of rainfall annually and the vegetation type is dry, deciduous sal forests.

Two major groupings of percent similarity for mammals between the different life zones were determined (Fig. 84). Life zones 1-5 show a 73% and life zones 6-9 a 74% similarity of mammals. But there is less than 50% similarity of mammals shared between the two major groupings.

Life zones 1-5 are lowland tropical and subtropical regions (300 to 2000 m), affected by monsoons, with wet types of deciduous forests. Life zones 6-9 are temperate subalpine and alpine regions (2000 to 8000 m) with evergreen and coniferous forests, not affected by the monsoons.

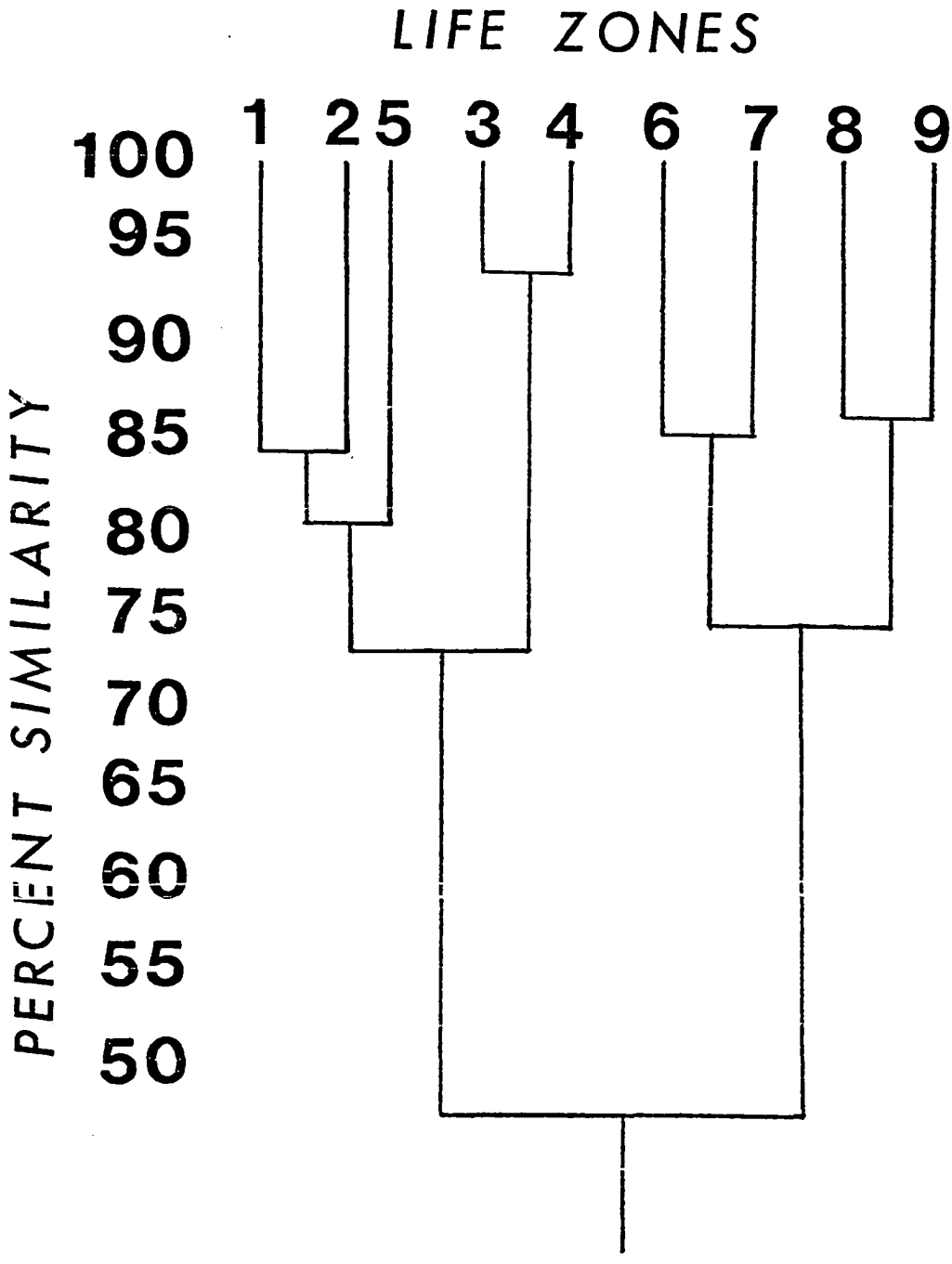


Fig. 84. Dendrogram showing the percent similarity of mammals shared between life zones

DISCUSSION

Host preference and specificity of fleas vary with a given host. According to Lewis (personal communication), fleas are more nest specific than host specific. The larval stages develop in nesting material of animals and the adults tend to attach to the first available host. Bat and bird fleas show a higher degree of host specificity than mammal fleas. There are several species of fleas that infest more than one category of hosts. These cosmopolitan fleas collected in Nepal were Ctenocephalides felis felis, C. f. orientis and Pulex irritans. Lewis (1972a, 1973b, 1974a, b, c & d, 1975), in a series of papers, has presented data on host preference of the order Siphonaptera.

In ticks, host preference may vary with the life cycle of each given species. All species pass through four stages (egg, larva, nymph and adult), but each may require one to three different hosts to complete its life cycle (James and Harwood 1969). The family Argasidae (soft-bodied ticks) are one-host ticks found chiefly on birds and bats. The family Ixodidae (hard-bodied ticks) require from one to three different hosts to complete their life cycle. Clifford et al. (1975) have reported on the life cycles and host preferences of the genus Ixodes from Nepal.

Mites were taken from 28.4% of all hosts examined by the Nepal Ectoparasite Program compared to 49.5% for the

Nepal Health Survey (Worth and Shah 1969). The difference is due to the small number (± 14%) of mites identified and processed by the Nepal Ectoparasite Program. Mites showed a high degree of preference for mammals (+99%).

Anoplura are strictly ectoparasites of mammals while Mallophaga are chiefly found on birds. Clay (1957) discussed the factors contributing to this high degree of host specificity of chewing lice for avian hosts.

Little information exists on the zoogeography of Nepalese birds and mammals. Cluster techniques were employed to analyze the faunal affinity of the area. The results for the geographic realm of origin for Nepalese birds were comparable to the results that Ali (1949), Ali and Ripley (1969) and Ripley (1961) derived on the origin of the birds from the Indian subcontinent. Diesselhorst (1968) reported on the spatial arrangement of birds for eastern Nepal. Our data for life zones were inconclusive for birds; it was next to impossible to ascertain the life zone of origin for them.

The mammal affinities for geographic realms and life zones coincide with data presented by Frick (1968), Gruber (1969) and Weigel (1969). Frick (1968) plotted 160 species of mammals (123 terrestrial) against three zoogeographic regions (Oriental, Palaearctic and Himalayan) and six life zones for Nepal. His results for the terrestrial mammals were: 55.6% (62) were Oriental, 24.2% (34) Palaearctic and

20.1% (27) Himalayan in origin. Darlington (1957) does not list a Himalayan faunal region, but he does divide the Oriental Region into an Indo-Chinese subregion to which Frick might be referring. If Frick were to combine the Himalayan and Oriental mammal data, his results (Oriental - 89 mammals; Palaearctic - 34 mammals) would approach mine (Oriental - 90; Palaearctic - 35).

An attempt was made to plot the ectoparasite affinity for geographic realms and life zones. Due to the extensive numbers of ectoparsites and the lack of zoogeographical information, the results obtained were inconclusive for certain groups. Therefore, this information was not included.

SUMMARY

A total of 5,192 collections (3,695 mammals, 474 birds, 595 livestock, 225 from humans and 203 other) was made during the six-year collecting period of the Nepal Ectoparasite Program. Mr. C. O. Maser made 587 collections, R. M. Mitchell, 4,042, while H. B. Emery and J. A. McNeely of the Arun Valley Wildlife Expedition collected the remaining 563.

As a result of our survey, 91 terrestrial species of mammals and 18 species of bats were collected. Seventeen species of land mammals, of which two may be new, are reported from Nepal for the first time:

Sorex minutus thibetanus
Suncus stoliczkanus
Crocidura horsfieldi
Crocidura attenuata rubricosa
Crocidura sp.
Nectogale elegans sikhimensis
Ochotona daurica curzoniae
Ochotona sp.
Belomys pearsoni
Vandeleuria oleracea modesta
Tatera indica
Pitymys leucurus
Vulpes ferrilata
Hyaena hyaena
Felis lynx isabellina
Tragulus meminna
Ovis ammon hodgsoni

A total of 36,527 ectoparasites representing six major taxonomic groups was identified and analyzed by computer: Fleas - 5,906 specimens; Ticks - 21,061 specimens; Diptera - 296 specimens; Mites - 3,705 specimens; Mallophaga - 3,398 specimens; Anoplura - 2,161 specimens.

A total of 5,906 fleas belonging to 40 genera and approximately 90 species was taken from 1,855 collections for a 28.7% infestation rate. The following represent new taxa:

Ancistropsylla nepalensis
Callopsylla fusca
Citellophilus mygala
Citellophilus atallahi
Chaetopsylla gracilis
Ctenophyllus triangularis
Genoneopsylla kunaveri
Mitchella exsula
Neopsylla mantissa
Neopsylla marleaneae
Neopsylla pagea
Palaeopsylla helenae
Palaeopsylla tauberi
Paradoxopsyllus acanthus
Paradoxopsyllus custodis
Paradoxopsyllus digitatus
Paradoxopsyllus hollandi
Paradoxopsyllus magnificus
Paradoxopsyllus mustangensis
Paradoxopsyllus oribatus
Paradoxopsyllus paraphaeopis
Paradoxopsyllus spinosus
Paraneopsylla ioffi nepali
Rowleyella arborea
Smitipsylla maseri
Smitipsylla prodigiosa
Stenischia pagiana

The remaining taxa are new to science and await description:

Amphipsylla sp. 1
Amphipsylla sp. 2
Callopsylla sp. 1
Callopsylla sp. 2
Ctenophyllus sp. 2
Ctenophyllus sp. 3
Hystrichopsylla sp.
Malaraeus n. sp.
Neopsylla sp.
Palaeopsylla #1
Palaeopsylla #2
Paradoxopsyllus n. sp.
Rhadinopsylla sp. 1
Rhadinopsylla sp. 2
Rhadinopsylla sp. 3
Rhadinopsylla sp. 4
Rhadinopsylla sp. 5
Rhadinopsylla sp. 6
Stenischia sp.
New Genus

Approximately 21,061 ticks were taken from 1,762 host collections. Eleven genera and 71 species infested approximately 27% of all hosts. Listed below are new taxa:

Anomalohimalaya lama
Argas himalayensis
Haemaphysalis ramachandrai
Ixodes hyatti
Ixodes mitchelli
Ixodes shahi

The following material is still under study and awaits description:

Amblyomma sp.
Ixodes sp.

Argas sp.	Ixodes sp.
Argas sp. #2	Ixodes sp. A
Dermacentor sp.	Ixodes sp. B
Haemaphysalis sp.	Ixodes sp. B facies
Hyalomma sp.	Rhipicephalus sp.

An accurate number of mites taken is still not available though it is considerably in excess of 50,000 specimens. Less than 14% (3,705) have been identified and processed to date. This includes 39 genera and 85 species.

The collections of parasitic Diptera are small (97) and their infestation rate low (1.5%). Fourteen genera and 21 species are reported.

Fifty genera and 126 species of Mallophaga representing 3,398 specimens were taken from 430 host collections. This represents a 6.67% infestation rate of all hosts. A number of these specimens have been determined only to genus.

The exact number of Anoplura taken is still unavailable, but 2,161 specimens from 478 host collections have been processed. Approximately 13 genera and 47 species were taken from 7.4% of all hosts checked.

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APPENDIX I.

STATISTICAL ANALYSIS FOR BODY MEASUREMENTS (in mm)

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Alticola stoliczkanus		
		Male (14)		
TL	127.03	118.5 - 133.9	5.19	5.08
T	26.82	21.1 - 29.3	2.80	10.44
HF	16.92	14.9 - 18.5	1.10	6.51
E	13.95	10.2 - 15.5	1.61	11.55
		Female (2)		
TL	128.90	124.7 - 133.1	5.93	4.60
T	28.35	23.2 - 33.5	7.28	25.69
HF	18.10	17.6 - 18.6	0.70	3.90
E	12.35	9.9 - 14.8	3.46	28.05
		Alticola stracheyi		
		Male (1)		
TL	112.30	112.3 - 112.3	0.0	0.0
T	18.00	18.0 - 18.0	0.0	0.0
HF	18.50	18.5 - 18.5	0.0	0.0
E	13.00	13.0 - 13.0	0.0	0.0
		Female (2)		
TL	122.75	118.6 - 126.9	5.86	4.78
T	23.90	23.5 - 24.3	0.56	2.36
HF	18.90	18.2 - 19.6	0.98	5.23
E	15.30	15.3 - 16.3	0.70	4.47
		Apodemus flavicollis gurkha		
		Male (35)		
TL	212.69	182.9 - 238.2	18.99	8.93
T	108.16	81.1 - 123.9	15.77	14.58
HF	25.20	19.8 - 27.4	1.29	5.15
E	17.88	15.6 - 19.5	1.28	7.18

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Apodemus flavicollis gurkha		
		Female (25)		
TL	201.14	173.3 - 290.3	22.94	11.40
T	102.48	81.6 - 139.1	11.07	10.80
HF	24.62	21.8 - 32.6	1.87	7.61
E	17.86	15.8 - 22.8	1.26	7.09
		Apodemus sylvaticus		
		Male (33)		
TL	187.07	161.9 - 227.3	14.20	7.59
T	91.55	71.1 - 111.9	9.45	10.32
HF	22.38	19.0 - 25.1	1.64	7.32
E	16.78	14.1 - 19.3	1.33	7.96
		Female (24)		
TL	184.68	169.6 - 219.9	10.81	5.85
T	94.59	82.4 - 115.0	7.07	7.47
HF	22.9	19.7 - 24.4	1.06	4.61
E	17.09	14.1 - 19.3	1.19	6.99
		Canis aureus		
		Male (2)		
TL	882.25	852.2 - 912.3	42.49	8.81
T	235.20	218.6 - 251.8	23.47	9.98
HF	155.75	153.1 - 158.4	3.74	2.40
E	72.55	70.6 - 74.5	2.75	3.80
		Female (3)		
TL	911.76	850.6 - 951.8	53.80	5.90
T	224.20	202.7 - 238.3	18.91	8.43
HF	153.00	149.1 - 157.6	4.29	2.80
E	72.83	72.0 - 73.4	0.73	1.01
		Cannomys badius		
		Female (2)		
TL	279.90	271.8 - 288.0	11.45	4.09
T	57.10	52.4 - 61.8	6.64	11.64
HF	35.60	35.0 - 36.2	0.84	2.38
E	8.05	8.0 - 8.1	0.07	0.87

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Crocidura horsfieldi		
		Male (4)		
TL	115.27	111.0 - 117.9	3.00	2.60
T	46.97	45.7 - 50.3	2.22	4.72
HF	12.70	12.3 - 13.1	0.40	3.21
E	7.80	7.4 - 8.2	0.32	4.18
		Female (2)		
TL	107.55	105.4 - 109.7	3.04	2.82
T	44.35	44.1 - 44.6	0.35	0.79
HF	12.40	11.8 - 13.0	0.84	6.84
E	7.65	7.3 - 8.0	0.49	6.47
		Crocidura sp. 1		
		Male (1)		
TL	123.60	123.6 - 123.6	0.0	0.0
T	54.00	54.0 - 54.0	0.0	0.0
HF	12.80	12.8 - 12.8	0.0	0.0
E	8.10	8.1 - 8.1	0.0	0.0
		Dremomys Lokriah		
		Male (3)		
TL	304.00	281.0 - 316.5	19.94	6.56
T	164.00	138.4 - 178.5	22.23	13.55
HF	47.80	46.9 - 49.2	1.22	2.57
E	20.20	19.5 - 21.0	0.75	3.73
		Female (6)		
TL	308.28	299.2 - 324.8	9.57	3.10
T	154.20	129.7 - 174.1	20.45	13.33
HF	45.81	41.3 - 49.3	2.75	6.00
E	20.01	18.2 - 22.4	1.38	6.93
		Felis bengalensis		
		Female (1)		
TL	774.40	774.4 - 774.4	0.0	0.0
T	291.00	291.0 - 291.0	0.0	0.0
HF	115.40	115.4 - 115.4	0.0	0.0
E	76.90	76.9 - 76.9	0.0	0.0

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Felis chaus		
		Male (4)		
TL	878.72	855.0 - 907.6	24.56	2.79
T	277.65	260.0 - 290.9	13.90	5.00
HF	156.57	144.0 - 168.7	10.21	6.52
E	71.45	68.5 - 74.5	2.55	3.58
		Female (8)		
TL	759.95	613.5 - 841.0	78.67	10.35
T	228.80	191.2 - 270.1	27.73	12.12
HF	131.42	116.2 - 149.8	12.65	9.62
E	64.72	52.4 - 75.3	6.95	10.74
		Felis viverrina		
		Female (1)		
TL	800.20	800.2 - 800.2	0.0	0.0
T	237.00	237.0 - 237.0	0.0	0.0
HF	135.90	135.9 - 135.9	0.0	0.0
E	43.40	43.4 - 43.4	0.0	0.0
		Funambulus pennanti		
		Male (10)		
TL	279.14	255.3 - 301.3	17.17	6.15
T	135.64	111.5 - 156.8	15.46	11.39
HF	38.78	36.7 - 42.3	1.92	4.97
E	15.01	14.2 - 16.2	0.67	4.49
		Female (4)		
TL	263.80	227.0 - 294.0	28.03	10.62
T	125.87	84.8 - 143.8	27.57	21.90
HF	37.97	34.9 - 39.8	2.12	5.60
E	15.27	14.8 - 16.0	0.55	3.60
		Golunda ellioti		
		Male (1)		
TL	236.00	236.0 - 236.0	0.0	0.0
T	115.10	115.1 - 115.1	0.0	0.0
HF	32.30	32.3 - 32.3	0.0	0.0
E	20.20	20.2 - 20.2	0.0	0.0

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Golunda ellioti		
		Female (2)		
TL	186.35	181.6 - 191.1	6.71	3.60
T	84.05	83.0 - 85.1	1.48	1.76
HF	24.80	22.9 - 26.7	2.68	10.83
E	15.25	14.7 - 15.8	0.77	5.10
		Herpestes edwardsi		
		Male (2)		
TL	686.65	570.3 - 803.0	164.54	23.96
T	306.25	236.4 - 376.1	98.78	32.25
HF	80.60	78.7 - 82.5	2.68	3.33
E	23.55	22.3 - 24.8	1.76	7.50
		Female (3)		
TL	712.80	672.2 - 758.6	43.43	6.09
T	352.06	337.4 - 375.8	20.74	5.89
HF	71.70	70.9 - 72.4	0.75	1.05
E	19.43	18.1 - 21.0	1.46	7.53
		Hylopetes alboniger		
		Male (1)		
TL	411.00	411.0 - 411.0	0.0	0.0
T	191.60	191.6 - 191.6	0.0	0.0
HF	45.80	45.8 - 45.8	0.0	0.0
E	32.20	32.2 - 32.2	0.0	0.0
		Female (2)		
TL	378.10	356.1 - 400.1	31.11	8.22
T	170.10	164.0 - 176.2	8.62	5.07
HF	39.50	38.6 - 40.4	1.27	3.22
E	29.95	28.8 - 31.1	1.62	5.43
		Lepus nigricollis ruficaudatus		
		Male (6)		
TL	495.58	458.7 - 520.1	24.62	4.97
T	88.50	73.5 - 98.6	10.48	11.84
HF	107.83	101.8 - 116.1	5.33	4.94
E	93.20	85.4 - 97.3	4.75	5.10

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Lepus nigricollis ruficaudatus		
		Female (3)		
TL	560.86	540.0 - 585.0	22.67	4.04
T	98.06	80.5 - 108.0	15.25	15.55
HF	112.30	111.1 - 113.3	1.11	0.99
E	93.50	88.5 - 98.9	5.21	5.57
		Martes flavigula		
		Male (1)		
TL	909.20	909.2 - 909.2	0.0	0.0
T	394.80	394.8 - 394.8	0.0	0.0
HF	101.90	101.9 - 101.9	0.0	0.0
E	33.50	33.5 - 33.5	0.0	0.0
		Millardia meltada pallidor		
		Male (2)		
TL	213.45	164.6 - 262.3	69.08	32.36
T	94.05	71.7 - 116.4	31.60	33.60
HF	22.90	21.0 - 24.8	2.68	11.73
E	19.65	16.1 - 23.2	5.02	25.54
		Female (6)		
TL	184.18	174.8 - 228.4	34.07	18.50
T	85.65	83.4 - 112.2	16.19	18.90
HF	22.65	21.6 - 23.8	0.79	3.51
E	18.20	15.9 - 20.5	1.68	9.25
		Mus booduga		
		Male (8)		
TL	116.72	100.5 - 138.5	12.08	10.34
T	55.86	47.9 - 69.8	7.04	12.60
HF	14.93	13.6 - 16.7	1.11	7.48
E	11.67	10.5 - 14.0	1.36	11.71
		Female (3)		
TL	120.80	107.8 - 129.7	11.51	9.52
T	55.53	53.6 - 57.7	2.05	3.70
HF	14.96	14.7 - 15.4	0.37	2.53
E	11.03	10.9 - 11.1	0.11	1.04

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Mus cervicolor		
		Male (2)		
TL	154.95	144.5 - 165.4	14.77	9.53
T	76.05	68.6 - 83.5	10.53	13.85
HF	16.95	16.7 - 17.2	0.35	2.08
E	13.50	13.0 - 14.0	0.70	5.23
		Mus musculus ssp.		
		Male (2)		
TL	155.20	149.4 - 161.0	8.20	5.28
T	80.50	78.5 - 82.5	2.82	3.51
HF	18.55	18.5 - 18.6	0.07	0.38
E	12.95	12.2 - 13.7	1.06	8.19
		Mus musculus homourus		
		Male (162)		
TL	137.79	111.9 - 167.5	9.23	6.70
T	68.27	57.3 - 84.2	6.01	8.81
HF	17.49	12.2 - 19.7	0.99	5.70
E	12.50	10.4 - 14.1	0.77	6.17
		Female (59)		
TL	136.64	112.9 - 160.9	11.35	8.31
T	68.65	54.1 - 80.1	6.61	9.63
HF	17.46	14.1 - 19.3	1.11	6.41
E	12.44	9.9 - 13.9	0.94	7.58
		Mus musculus urbanus		
		Male (150)		
TL	158.39	137.1 - 180.2	12.88	8.13
T	79.15	66.7 - 87.5	8.09	10.22
HF	18.55	16.1 - 25.5	0.96	5.21
E	13.83	11.0 - 17.4	0.94	6.79
		Female (90)		
TL	160.14	114.9 - 182.3	10.92	6.82
T	80.41	56.8 - 94.0	5.99	7.45
HF	18.29	16.0 - 19.8	0.68	3.75
E	13.94	12.1 - 15.9	0.83	5.99

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Mus platythrix		
		Male (1)		
TL	181.00	181.0 - 181.0	0.0	0.0
T	79.80	79.8 - 79.8	0.0	0.0
HF	19.20	19.2 - 19.2	0.0	0.0
E	16.70	16.7 - 16.7	0.0	0.0
		Female (1)		
TL	160.30	160.3 - 160.3	0.0	0.0
T	70.10	70.1 - 70.1	0.0	0.0
HF	17.80	17.8 - 17.8	0.0	0.0
E	15.50	15.5 - 15.5	0.0	0.0
		Mustela altaica		
		Male (1)		
TL	381.00	381.0 - 381.0	0.0	0.0
T	130.20	130.2 - 130.2	0.0	0.0
HF	41.20	41.2 - 41.2	0.0	0.0
E	20.50	20.5 - 20.5	0.0	0.0
		Mustela sibirica		
		Male (4)		
TL	446.57	418.5 - 506.5	40.87	9.15
T	160.75	147.1 - 174.3	13.27	8.25
HF	49.52	46.3 - 52.2	2.65	5.35
E	21.85	20.4 - 24.9	2.05	9.41
		Female (2)		
TL	407.10	375.7 - 438.5	44.40	10.90
T	139.10	130.3 - 147.9	12.44	8.94
HF	46.40	42.3 - 50.5	5.79	12.49
E	20.80	19.3 - 22.3	2.12	10.19
		Nesokia indica		
		Female (3)		
TL	223.30	196.1 - 273.5	43.52	19.49
T	79.80	68.6 - 102.0	19.22	24.09
HF	30.86	29.2 - 34.2	2.88	9.35
E	15.03	12.9 - 18.7	3.18	21.21

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Ochotona daurica		
		Male (1)		
TL	196.50	196.5 - 196.5	0.0	0.0
T	6.50	6.5 - 6.5	0.0	0.0
HF	34.50	34.5 - 34.5	0.0	0.0
E	21.10	21.1 - 21.1	0.0	0.0
		Ochotona macrotis		
		Male (1)		
TL	191.10	191.1 - 191.1	0.0	0.0
T	8.40	8.4 - 8.4	0.0	0.0
HF	33.40	33.4 - 33.4	0.0	0.0
E	38.80	38.8 - 38.8	0.0	0.0
		Ochotona roylei		
		Male (21)		
TL	176.10	153.3 - 202.6	12.95	7.35
T	5.83	4.5 - 6.8	0.63	10.92
HF	33.81	33.1 - 34.8	0.37	1.11
E	23.22	18.8 - 25.2	1.56	6.73
		Female (21)		
TL	177.55	159.8 - 198.5	10.94	6.16
T	6.06	5.1 - 7.3	0.57	9.45
HF	33.57	32.8 - 34.3	0.35	1.05
E	23.11	21.0 - 24.5	0.85	3.71
		Ochotona sp.		
		Male (1)		
TL	170.30	170.3 - 170.3	0.0	0.0
T	6.50	6.5 - 6.5	0.0	0.0
HF	34.80	34.8 - 34.8	0.0	0.0
E	20.00	20.0 - 20.0	0.0	0.0
		Female (1)		
TL	170.20	170.2 - 170.2	0.0	0.0
T	6.50	6.5 - 6.5	0.0	0.0
HF	34.20	34.2 - 34.2	0.0	0.0
E	19.80	19.8 - 19.8	0.0	0.0

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Paradoxurus hermaphroditus		
		Female (1)		
TL	998.00	998.0 - 998.0	0.0	0.0
T	483.70	483.7 - 483.7	0.0	0.0
HF	79.20	79.2 - 79.2	0.0	0.0
E	44.60	44.6 - 44.6	0.0	0.0
		Petaurista elegans		
		Male (2)		
TL	666.50	664.5 - 668.5	2.82	0.42
T	351.80	351.6 - 352.0	0.28	0.08
HF	68.50	67.4 - 69.6	1.55	2.27
E	41.35	39.8 - 42.9	2.19	5.30
		Female (3)		
TL	603.83	529.8 - 657.0	66.11	10.95
T	313.30	284.0 - 330.4	25.49	8.13
HF	66.76	61.1 - 70.7	5.02	7.53
E	41.80	40.3 - 43.3	1.50	3.58
		Petaurista magnificus		
		Male (7)		
TL	851.91	813.8 - 877.0	22.78	2.67
T	455.98	428.5 - 474.1	16.60	3.64
HF	80.87	78.2 - 84.3	2.23	2.75
E	42.35	40.5 - 45.9	1.88	4.44
		Female (4)		
TL	836.57	800.0 - 862.4	28.15	3.36
T	449.50	400.0 - 474.5	33.76	7.51
HF	79.90	75.5 - 82.7	3.16	3.96
E	38.00	31.1 - 42.8	5.17	13.62
		Pitymys leucurus		
		Male (7)		
TL	132.78	120.2 - 149.0	10.42	7.85
T	24.35	20.4 - 29.4	3.38	13.90
HF	18.70	17.9 - 19.2	0.46	2.48
E	9.87	7.9 - 11.2	1.36	13.86

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Female (3)		
TL	129.23	122.3 - 137.7	7.81	6.04
T	25.06	22.7 - 28.4	2.97	11.85
HF	18.16	18.0 - 18.5	0.28	1.58
E	10.13	9.8 - 10.6	0.41	4.10
		Pitymys sikimensis		
		Male (82)		
TL	141.65	121.1 - 164.0	9.88	6.97
T	36.45	30.2 - 48.0	3.62	9.93
HF	20.12	18.5 - 22.2	0.82	4.10
E	13.00	10.5 - 24.5	1.66	12.78
		Female (57)		
TL	143.70	121.5 - 161.3	10.47	7.28
T	37.28	30.8 - 45.4	3.49	9.38
HF	20.02	16.8 - 25.5	1.18	5.90
E	13.10	11.2 - 15.2	0.88	6.73
		Rattus eha		
		Male (26)		
TL	271.41	239.0 - 304.6	23.40	8.62
T	161.94	140.3 - 189.4	17.59	10.86
HF	27.05	24.6 - 29.8	1.63	6.05
E	19.63	17.1 - 21.2	1.29	6.60
		Female (14)		
TL	280.57	252.7 - 304.8	15.98	5.69
T	166.04	151.1 - 178.3	8.59	5.17
HF	26.68	25.5 - 28.0	0.85	3.19
E	20.16	18.2 - 21.7	0.96	4.76
		Rattus fulvescens		
		Male (11)		
TL	282.45	252.7 - 320.8	22.34	7.91
T	166.37	144.4 - 203.1	17.95	10.79
HF	27.57	24.8 - 30.7	2.02	7.36
E	19.69	16.6 - 28.8	3.24	16.46

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Rattus fulvescens		
		Female (11)		
TL	286.25	229.5 - 323.6	33.02	11.53
T	163.04	136.3 - 193.2	25.53	15.66
HF	26.81	23.2 - 29.9	2.03	7.58
E	19.09	16.4 - 20.6	1.47	7.75
		Rattus rattus brunneus		
		Male (2)		
TL	406.35	404.3 - 408.4	3.89	0.71
T	212.35	211.1 - 213.6	1.76	0.83
HF	38.75	38.3 - 39.2	0.63	1.64
E	24.75	24.0 - 25.5	1.06	4.28
		Female (1)		
TL	380.10	380.1 - 380.1	0.0	0.0
T	206.90	206.9 - 206.9	0.0	0.0
HF	36.70	36.7 - 36.7	0.0	0.0
E	27.90	27.9 - 27.9	0.0	0.0
		Rattus rattus brunneusculus		
		Male (17)		
TL	363.41	258.9 - 436.3	48.35	13.30
T	196.82	139.3 - 230.3	28.50	14.48
HF	35.20	27.4 - 38.8	2.79	7.94
E	23.84	19.8 - 26.1	1.71	7.19
		Female (21)		
TL	325.64	252.6 - 390.8	65.06	19.97
T	180.56	128.0 - 221.5	36.28	20.09
HF	32.83	25.6 - 36.8	3.47	10.57
E	22.91	19.0 - 26.2	2.51	10.97
		Rattus turkestanicus		
		Male (17)		
TL	327.98	305.4 - 352.4	17.08	5.20
T	168.46	149.3 - 191.6	11.38	6.76
HF	33.81	31.5 - 36.7	1.43	4.23
E	23.59	21.0 - 25.4	1.17	4.96

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Rattus turkestanicus		
		Female (19)		
TL	326.76	278.5 - 382.7	24.51	7.50
T	161.50	137.3 - 217.7	37.36	23.13
HF	33.21	30.1 - 34.8	1.37	4.14
E	23.70	21.1 - 26.4	1.26	5.31
		Rattus nitidus		
		Male (2)		
TL	261.10	247.7 - 274.5	13.95	7.25
T	138.70	128.9 - 148.5	13.85	9.99
HF	29.30	29.3 - 29.3	0.0	0.0
E	20.40	19.8 - 21.0	0.84	4.15
		Female (1)		
TL	255.10	255.1 - 255.1	0.0	0.0
T	126.00	126.0 - 126.0	0.0	0.0
HF	29.10	29.1 - 29.1	0.0	0.0
E	18.10	18.1 - 18.1	0.0	0.0
		Rattus niviventer		
		Male (6)		
TL	235.95	157.9 - 274.6	41.88	17.75
T	125.85	116.5 - 147.0	20.65	16.41
HF	26.45	22.9 - 30.9	4.77	18.03
E	18.80	15.0 - 21.0	2.36	12.57
		Female (9)		
TL	264.58	240.5 - 282.1	14.82	5.60
T	139.64	121.2 - 155.1	10.37	7.42
HF	28.02	24.0 - 31.8	2.34	8.38
E	20.54	17.1 - 22.6	1.63	7.94
		Rattus rattus ssp.		
		Male (4)		
TL	328.72	306.5 - 348.1	19.77	6.01
T	171.05	158.6 - 197.4	18.05	10.55
HF	34.25	32.4 - 35.1	1.25	3.65
E	22.45	20.8 - 24.7	1.67	7.44

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Rattus rattus ssp.		
		Female (7)		
TL	364.81	302.8 - 396.3	33.10	9.07
T	193.38	161.4 - 219.4	21.46	11.09
HF	34.28	31.6 - 39.9	3.54	10.33
E	23.77	19.4 - 26.1	2.21	9.32
		Sorex cylindricauda		
		Male (11)		
TL	126.41	118.6 - 138.3	5.93	4.69
T	58.02	52.8 - 63.1	3.15	5.44
HF	14.80	14.1 - 15.3	0.40	2.75
E	8.58	7.3 - 9.1	0.58	6.87
		Female (6)		
TL	126.46	120.5 - 132.3	4.45	3.52
T	58.55	53.9 - 62.4	3.29	5.62
HF	14.91	14.0 - 15.3	0.47	3.21
E	8.88	8.5 - 9.1	0.23	2.60
		Sorex minutus		
		Male (2)		
TL	91.15	91.1 - 91.2	0.07	0.07
T	36.80	34.9 - 38.7	2.68	7.30
HF	12.10	11.7 - 12.5	0.56	4.67
E	4.75	4.0 - 5.5	1.06	22.33
		Female (2)		
TL	98.85	91.1 - 106.6	10.96	11.08
T	37.60	32.1 - 43.1	7.7	20.68
HF	12.30	11.8 - 12.8	0.70	5.74
E	5.65	5.3 - 6.0	0.49	8.76
		Soriculus caudatus		
		Male (46)		
TL	116.94	105.3 - 129.4	5.93	5.07
T	55.13	42.7 - 63.1	4.36	7.91
HF	13.95	11.6 - 15.5	0.84	6.03
E	7.92	6.1 - 9.4	0.65	8.23

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Soriculus caudatus		
		Female (42)		
TL	118.20	109.9 - 127.9	5.06	4.28
T	55.91	48.5 - 61.5	2.77	4.96
HF	13.95	11.1 - 15.5	0.96	6.92
E	7.94	6.8 - 9.1	0.58	7.39
		Soriculus leucops		
		Male (2)		
TL	147.25	143.7 - 150.8	5.02	3.40
T	88.35	87.5 - 89.2	1.20	1.36
HF	15.40	14.8 - 16.0	0.84	5.51
E	8.90	8.6 - 9.2	0.42	4.76
		Soriculus nigrescens		
		Male (64)		
TL	130.08	116.8 - 144.2	6.39	4.91
T	44.09	36.6 - 51.8	3.72	8.45
HF	16.32	14.1 - 17.4	0.79	4.84
E	8.77	7.1 - 10.0	0.70	8.02
		Female (62)		
TL	131.74	114.3 - 149.1	6.77	5.14
T	45.02	36.6 - 51.5	3.60	7.99
HF	16.16	11.9 - 17.8	1.14	7.09
E	8.65	6.6 - 9.7	0.62	7.19
		Suncus etruscus pygmaeoides		
		Male (2)		
TL	78.65	75.5 - 81.8	4.45	5.66
T	31.45	30.1 - 32.8	1.90	6.07
HF	8.80	8.1 - 9.5	0.98	11.24
E	6.00	5.8 - 6.2	0.28	4.71
		Female (1)		
TL	79.50	79.5 - 79.5	0.0	0.0
T	29.20	29.2 - 29.2	0.0	0.0
HF	8.50	8.5 - 8.5	0.0	0.0
E	5.90	5.9 - 5.9	0.0	0.0

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Suncus murinus		
		Male (8)		
TL	184.07	133.1 - 206.1	23.77	12.91
T	71.82	60.5 - 81.0	7.05	9.82
HF	21.40	18.3 - 25.9	3.34	15.63
E	11.06	7.5 - 13.7	1.84	16.64
		Female (17)		
TL	180.98	143.1 - 218.5	20.28	11.21
T	69.08	43.0 - 81.3	9.23	13.36
HF	20.48	18.4 - 24.0	1.61	7.86
E	11.07	8.0 - 12.7	1.26	11.42
		Tatera indica		
		Female (3)		
TL	343.16	327.0 - 357.1	15.17	4.42
T	183.93	182.5 - 186.0	1.83	0.99
HF	40.90	40.4 - 41.3	0.45	1.12
E	23.66	22.2 - 25.3	1.55	6.57
		Vandeleuria oleracea dumeticola		
		Male (2)		
TL	147.50	128.6 - 166.4	26.72	18.12
T	84.90	78.7 - 101.1	22.91	26.98
HF	16.70	16.1 - 17.3	0.84	5.08
E	12.25	11.6 - 12.9	0.91	7.50
		Vandeleuria oleracea modesta		
		Male (3)		
TL	133.56	126.0 - 138.8	6.71	5.02
T	68.53	67.3 - 70.0	1.36	1.99
HF	16.96	16.0 - 17.6	0.85	5.01
E	12.06	11.7 - 12.3	0.32	2.66
		Female (5)		
TL	143.65	130.3 - 174.4	20.68	14.39
T	70.65	62.8 - 81.6	8.27	11.71
HF	17.35	15.2 - 18.9	1.57	9.08
E	12.0	10.9 - 12.9	0.88	7.39

Measurements	Mean	Range	Standard deviation	Coefficient variance(%)
		Vulpes bengalensis		
		Male (3)		
TL	747.40	713.2 - 771.0	30.32	4.05
T	276.70	268.0 - 291.1	12.56	4.53
HF	121.96	120.5 - 123.0	1.30	1.07
E	77.20	72.3 - 80.2	4.27	5.54
		Female (2)		
TL	785.55	762.6 - 808.5	32.45	4.13
T	292.70	288.4 - 297.0	6.08	2.07
HF	114.45	111.1 - 117.8	4.73	4.13
E	76.15	76.0 - 76.3	0.21	0.27
		Vulpes ferrilata		
		Male (1)		
TL	1030.00	1030.0 - 1030.0	0.0	0.0
T	461.00	461.0 - 461.0	0.0	0.0
HF	153.00	153.0 - 153.0	0.0	0.0
E	90.00	90.0 - 90.0	0.0	0.0

APPENDIX II.

HOST SPECIFICITY OF ECTOPARASITES (70% CRITERION)

Ectoparasite	Host (n)	Occurrence(%)
Siphonaptera		
Amphalius clarus	Ochotona roylei(54)	091.53
Amphipsylla sp. 2	Alticola stoliczkanus(20)	086.96
Ancistropsylla nepalensis	Axis axis(8)	072.73
Callopsylla kaznakovi	Mustela altaica(1)	100.00
Callopsylla gemina	Columba leuconota(1)	100.00
Ceratophyllus fringillae	Ochotona daurica(1)	100.00
Chaetopsylla lasia	Capra hircus (goat)(1)	100.00
Ctenophyllus (Geusibia)	Ochotona roylei(60)	088.24
Doratopsylla coreana	Sorex cylindricauda(5)	083.33
Euhoplopsyllus glacialis profugus	Lepus oiostolus(2)	100.00
Frontopsylla spadix	Rattus eha(5)	100.00
Ischnopsyllus indicus	Pipistrellus babu(1)	100.00
Mitchella exsula	Pipistrellus babu(1)	100.00
Neopsylla mantissa	Pitymys sikimensis(24)	092.31
Neopsylla pagea	Pitymys sikimensis(14)	073.68
Paradoxopsyllus mustangensis	Rattus turkestanicus(11)	084.62
Paradoxopsyllus oribatus	Apodemus sylvaticus (21)	095.45
Paradoxopsyllus paraphaeopis	Rattus rattus(1)	100.00
Paraneopsylla ioffi nepali	Ochotona roylei(12)	085.71
Rowleyella arborea	Dremomys lokriah(4)	100.00
Stenischia pagiana	Soriculus nigrescens(3)	100.00
Stenoponia himalayana	Pitymys sikimensis(30)	076.92
Lentistivalius ferinis	Suncus murinus(12)	100.00
New genus	Alticola stoliczkanus(6)	075.00
Peromyscopsylla himalaica	Rat(1)	100.00
Malaraeus n. sp.	Pitymys sikimensis(4)	080.00
Ixodoidea		
Argas himalayensis	Lerwa Lerwa(1)	100.00
Argas sp.	Eptesicus sp.(1)	100.00
Dermacentor atrosignatus	Free-living(Flagging(2) etc.)	100.00
Haemaphysalis cornupunctata	Capra hircus(1)	100.00
Haemaphysalis darjeeling	Homo sapiens(1)	100.00
Hyalomma detritum	Cervus unicolor(1)	100.00
Hyalomma marginatum turanicum	Capra hircus(3)	075.00

Ectoparasite	Host (n)	Occurrence(%)
Ixodes kuntzi	Petaurista magnificus(1)	100.00
Ixodes berlesei	Carpodacus nipalensis(1)	
Ornithodoros coniceps	Free-living (flagging(1) etc.)	100.00
Ornithodoros (Reticulinasus) piriformis	Free-living (flagging(13) etc.)	086.67
Rhipicephalus ramachandrai	Tatera indica(1)	100.00
Rhipicephalus sanguineus	Canis aureus(1)	100.00
Diptera		
Hippobosca longipennis	Canis familiaris(5)	100.00
Hippobosca sp.	Delichon nipalensis(3)	075.00
Icosta maquilingensis	Gallus gallus(3)	100.00
Lipoptena axis	Axis axis(7)	070.00
Lipoptena pauciseta	Muntiacus muntjak(1)	100.00
Lipoptena timida	Axis axis(1)	100.00
Melophagus ovinus	Ovis aries(3)	100.00
Ornithoica bistativa	Pavo cristatus(1)	100.00
Ornithomya avicularia	Ithaginis cruentus(1)	100.00
Ornithophila metallica	Dendrocitta vagabunda(1)	100.00
Pseudolynchia canariensis	Columba livia(5)	083.33
Cyclopodia sykesii	Pteropus giganteus(16)	100.00
Streblids	Rhinolophus lepidus(1)	100.00
Mites		
Allodermanyssus sanguineus	Suncus murinus(1)	100.00
Androlaelaps macroventralis	Petaurista elegans(2)	100.00
Androlaelaps marshalli	Tatera indica(2)	100.00
Androlaelaps traubi	Callosciurus pygerythrus (1)	100.00
Androlaelaps triangularis	Soriculus nigrescens(2)	100.00
Dermanyssus sp.	Carpodacus erythrinus(1)	100.00
Gahrliepia (Schoengastiella) sp.	Suncus murinus(5)	083.33
Haemogamasus sp.	Soriculus nigrescens(5)	071.43
Haemogamasus dorsalis	Rattus rattus(3)	100.00
Haemogamasus horridus	Pitymys sikimensis(1)	100.00
Haemogamasus japonicus	Pitymys sikimensis(2)	100.00
Haemolaelaps fahrenholzi	Pitymys sikimensis(2)	100.00
Hypoaspis miles	Tatera indica(1)	100.00
Laelaps agilis	Apodemus sylvaticus(13)	100.00
Laelaps buxtoni	Tatera indica(1)	100.00
Neolaelaps spinosus	Pteropus giganteus(7)	100.00
Myonyssus montanus	Ochotona roylei(18)	090.00
Ornithonyssus sylviarum	Oriolus xanthornus(1)	100.00
Pellonyssus viator	Hirundo daurica(1)	100.00

Ectoparasite	Host (n)	Occurrence(%)
Pterodectes leioplax	Kitta (Cissa) flavirostris(1)	100.00
Rhyzolaelaps inaequipitis	Cannomys badius(2)	100.00
Spinturnex plecotinus	Barbastella leucomelas(1)	100.00
Falculifer rostratus	Streptopelia orientalis(1)	100.00
Pterolichus obtusus	Gallus gallus(2)	100.00
Sokoloviana sp.	Vanellus spinosus(1)	100.00
Amerosiidae	Apodemus flavicollis gurkha(1)	100.00
Polylaelaptidae	Suncus murinus(1)	100.00
Phytoseiidae	Pteropus giganteus(1)	100.00
Listrophoridae	Mus musculus(1)	100.00
Mallophaga		
Amyrsidea minuta	Pavo cristatus(4)	100.00
Amyrsidea phaeostoma	Pavo cristatus(2)	100.00
Amyrsidea sp.	Lophophorus impejanus(3)	075.00
Amyrsidea elbeli	Arbophilia rufogularis(1)	100.00
Bovicola limbata	Capra hircus(7)	100.00
Bovicola caprae	Capra hircus(1)	100.00
Bovicola dimorpha	Nemorhaedus goral(2)	100.00
Bovicola sp.	Capra hircus(1)	100.00
Bovicola thompsoni	Capricornis sumatraensis(1)	100.00
Bruelia daumae	Zoothera dauma(1)	100.00
Bruelia mahrastan	Turdoides stratus somervillei(5)	100.00
Bruelia meinertzhageni	Dendrocitta vagabunda(1)	100.00
Bruelia saliemi mollii	Corvus macrorhynchus(1)	100.00
Bruelia sehri	Garrulax lineatus(4)	100.00
Chelopistes lervicola	Lerwa lerwa(8)	100.00
Colinocola meinertzhageni	Lerwa lerwa(7)	077.78
Colpocephalum tausi	Pavo cristatus(4)	100.00
Colpocephalum turbinatum	Bubo (Ketupa) zeylonensis(1)	100.00
Columbicola guimaraesi	Chalcophaps indica(2)	100.00
Columbicola orientalis	Streptopelia orientalis(5)	100.00
Columbicola tschulyschman	Columba leuconota(6)	100.00
Craspedorrhynchus nisi	Accipiter nisus(1)	100.00
Craspedorrhynchus spathulatus	Milvus migrans(1)	100.00
Cuculogaster theresae	Francolinus francolinus(3)	100.00
Cuculogaster obscurior	Alectoris graeca(1)	100.00
Cuculiphilus snodgrassi	Centropus sinensis(1)	100.00
Degeeriella rufarufa	Falco tinnunculus(1)	100.00
Falcolius jordani	Microhierax caerulescens(2)	100.00
Goniocotes creber	Lophura leucomelana(1)	100.00

Ectoparasite	Host (n)	Occurrence(%)
Goniocotes haplogonus	Lophophorus impejanus(18)	094.74
Goniocotes rectangulatus	Pavo cristatus(1)	100.00
Goniocotes diplogonus	Tragopan satyra(2)	100.00
Goniocotes alatus	Alectoris graeca(1)	100.00
Goniocotes gallinae	Gallus gallus(2)	100.00
Gonoides dentatus	Lophura leucomelana(2)	100.00
Gonoides dispar	Alectoris graeca(1)	100.00
Gonoides dissimilis	Gallus gallus(5)	100.00
Gonoides eurygaster	Lophophorus impejanus(23)	095.83
Gonoides ithaginis	Ithaginis cruentus(5)	083.33
Goncides megaceros	Lophophorus impejanus(2)	100.00
Gonoides meinertzhageni	Pavo cristatus(1)	100.00
Gonoides pavonis	Pavo cristatus(4)	100.00
Gonoides sp.	Lophura leucomelana(2)	100.00
Gonoides spinicornis	Tragopan satyra(3)	100.00
Kurodaia deignani	Glaucidium cuculoides(2)	100.00
Laemobothrion maximum	Milvus migrans(1)	100.00
Laemobothrion tinnunculi	Falco tinnunculus(1)	100.00
Lagopoecus heterotypus	Lophophorus impejanus(13)	100.00
Lagopoecus sp.	Ithaginis cruentus(5)	071.43
Lagopoecus meinertzhageni	Lerwa lerwa(1)	100.00
Lipeurus caponis	Gallus gallus(6)	085.71
Lipeurus pavo	Pavo cristatus(4)	100.00
Lipeurus introductus	Lophura leucomelana(1)	100.00
Menacanthus stramineus	Gallus gallus(1)	100.00
Menacanthus merisuoi	Nucifraga caryocatactes(1)	100.00
Menopon gallinae	Gallus gallus(9)	081.82
Menopon interpositum	Francolinus francolinus(1)	100.00
Meropoecus caprai	Merops orientalis(1)	100.00
Myrsidea anaspila	Corvus corax(1)	100.00
Myrsidea shirakii himalayensis	Corvus macrorhynchus(1)	100.00
Myrsidea brunea	Nucifraga caryocatactes(1)	100.00
Oxylipeurus baileyi ithaginis	Ithaginis cruentus	071.43
Oxylipeurus himalayensis burmeisteri	Lophophorus impejanus(23)	088.00
Oxylipeurus formosanus	Arbophilia rufogularis(1)	100.00
Quadraceps bicuspis	Charadrius dubius(1)	100.00
Quadraceps dasi	Lobivanellus indicus(1)	100.00
Quadraceps hoplopteri	Vanellus spinosus(5)	083.33
Quadraceps insignis	Sterna aurantia(1)	100.00
Quadraceps sp.	Cannomys badius(1)	100.00
Strachiella mustelae	Mustela sibirica(1)	100.00
Strigiphilus bramae	Bubo (Ketupa) zeylonensis(1)	100.00
Strigiphilus ketupae	Strix leptogrammica(1)	100.00
Turnicola angustissimus	Turnix suscitator(3)	100.00

Ectoparasite	Host (n)	Occurrence(%)
Alcedoecus annularis	*Halcyon smyrnensis*(1)	100.00
Meromenopon sp.	*Merops orientalis*(1)	100.00
Alcedoffula alcedinis	*Alcedo athis*(1)	100.00
Cuculicola sp.	*Taccocua leschenaultii*(1)	100.00
Mulcticola sp.	*Caprimulgus indicus*(1)	100.00
Echinophilopterus sp.	*Psittacula himalayana*(1)	100.00
Campanulotes heteroceros	*Columba leuconota*(2)	100.00
Austromenopon sp.	*Vanellus spinosus*(1)	100.00
Anoplura		
Ancistroplax crocidurae	*Soriculus caudatus*(2)	100.00
Enderleinellus nishimauri	*Funambulus pennanti*(1)	100.00
Haematopinus eurysternus	*Boselaphus tragocamelus*(1)	100.00
Haematopinus suis	*Sus scrofa*(2)	100.00
Haematopinus tuberculatus	*Bubalus babalis*(24)	088.89
Haemodipsus ventricosus	*Lepus nigricollis ruficaudatus*(2)	100.00
Hoplopleura acanthopus	*Pitymys sikimensis*(52)	088.14
Hoplopleura maniculata	*Funambulus pennanti*(10)	090.91
Hoplopleura oenomidus	*Rattus eha*(6)	075.00
Hoplopleura dissicula	*Rattus eha*(3)	100.00
Hoplopleura affinis	*Apodemus sylvaticus*(3)	100.00
Hoplopleura erismata	*Callosciurus pygerythrus*(2)	100.00
Linognathus africanus	*Capra hircus*(10)	076.92
Linognathus setosus	*Canis aureus*(3)	075.00
Linognathus vituli	*Bos taurus*(8)	072.73
Linognathus sp.	*Bos* sp. (Zhumo & Zhupiah)(1)	100.00
Neohaematopinus echinatus	*Funambulus pennanti*(8)	100.00
Neohaematopinus elbeli	*Dremomys lokriah*(2)	100.00
Neohaematopinus petauristae	*Petaurista magnificus*(5)	100.00
Pediculus humanus	*Homo sapiens*(19)	073.08
Polyplax pricei	*Rattus nitidus*(1)	100.00
Polyplax reclinata	*Suncus murinus*(11)	100.00
Polyplax spinulosa	*Tatera indica*(2)	100.00
Polyplax stephensi	*Mus musculus urbanus*(1)	100.00
Polyplax serrata	*Rattus nitidus*(1)	100.00
Solenopotes capillatus	*Axis axis*(2)	100.00
Solenopotes muntiacus	*Muntiacus muntjak*(3)	100.00
Parafelicola viverriculae	*Viverra* sp.(1)	100.00

APPENDIX III.

TOTAL NUMBER OF ECTOPARASITES COLLECTED

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Siphonaptera			
Acropsylla episema	8	000.14	000.02
Amphalius clarus	119	002.01	000.33
Amphipsylla quadratedigita	25	000.42	000.07
Amphipsylla sp. 1	20	000.34	000.05
Amphipsylla sp. 2	183	003.10	000.50
Ancistropsylla nepalensis	163	002.76	000.45
Callopsylla fusca	30	000.51	000.08
Callopsylla kaznakovi	1	000.02	000.00
Callopsylla gemina	3	000.05	000.01
Citellophilus mygala	61	001.03	000.17
Citellophilus atallahi	13	000.22	000.04
Callopsylla sp. 1	62	001.05	000.17
Ceratophyllus enefdei	7	000.12	000.02
Ceratophyllus fringillae	1	000.02	000.00
Ceratopsyllus gallinae gallinae	2	000.03	000.01
Chaetopsylla gracilis	19	000.32	000.05
Chaetopsylla homoea homoea	106	001.79	000.29
Chaetopsylla lasia	1	000.02	000.00
Ctenocephalides felis felis	64	001.08	000.18
Ctenocephalides felis orientis	828	014.02	002.27
Ctenophyllus (Geusibia)	194	003.28	000.53
Ctenophyllus triangularis	5	000.08	000.01
Ctenophyllus sp. 3	3	000.05	000.01
Dasypsyllus gallinulae	4	000.07	000.01
Doratopsylla coreana	9	000.15	000.02
Euhoplopsyllus glacialis profugus	4	000.07	000.01
Frontopsylla sp.	53	000.90	000.15
Frontopsylla spadix	11	000.19	000.03
Genoneopsylla longisetosa	19	000.32	000.05
Hystrichopsylla n. sp.	13	000.22	000.04
Ischnopsyllus indicus	1	000.02	000.00
Macrostylophora hastata	3	000.05	000.01
Macrostylophora lupata	81	001.37	000.23
Mitchella exsula	1	000.02	000.00
Neopsylla angustimanubra	41	000.59	000.11
Neopsylla mantissa	44	000.75	000.12
Neopsylla marleaneae	210	003.56	000.57

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Neopsylla pagea	31	000.52	000.08
Neopsylla secura	676	011.45	001.85
Neopsylla sp.	4	000.07	000.01
Neopsylla stevensi	13	000.22	000.04
Nosopsyllus sp.	80	001.35	000.22
Nosopsyllus punjabensis	40	000.68	000.11
Nosopsyllus simla	20	000.34	000.05
Palaeopsylla helenae	215	003.64	000.59
Palaeopsylla remota	32	000.54	000.09
Palaeopsylla tauberi	301	005.10	000.82
Palaeopsylla #1	5	000.08	000.01
Palaeopsylla #2	10	000.17	000.03
Palaeopsylla #3	2	000.03	000.01
Paraceras sauteri	9	000.15	000.02
Paradoxopsyllus acanthus	169	002.86	000.46
Paradoxopsyllus custodis	35	000.59	000.10
Paradoxopsyllus digitatus	34	000.58	000.09
Paradoxopsyllus n. sp.	14	000.24	000.04
Paradoxopsyllus hollandi	46	000.78	000.13
Paradoxopsyllus magnificus	42	000.71	000.11
Paradoxopsyllus mustangensis	34	000.58	000.09
Paradoxopsyllus oribatus	48	000.81	000.13
Paradoxopsyllus paraphaeopis	3	000.05	000.01
Paradoxopsyllus spinosus	4	000.24	000.04
Paraneopsylla ioffi nepali	17	000.29	000.05
Pulex irritans	182	003.08	000.50
Rhadinopsylla sp. 1	29	000.49	000.08
Rhadinopsylla sp. 2	14	000.24	000.04
Rowleyella arborea	21	000.36	000.06
Smitipsylla maseri	196	003.32	000.54
Smitipsylla prodigiosa	5	000.08	000.01
Stenischia pagiana	3	000.05	000.01
Stenischia sp.	54	000.91	000.15
Stenoponia himalayana	107	001.81	000.29
Stivalius aporus	7	000.12	000.02
Lentistivalius ferinis	29	000.49	000.08
Thaumapsylla breviceps orientalis	493	008.35	001.35
Vermipsylla alakurt	313	005.30	000.86
Xenodaeria telios	87	001.47	000.24
Xenopsylla astia	23	000.39	000.06
Xenopsylla cheopis	2	000.03	000.01
New genus	17	000.29	000.05
Peromyscopsylla himalaica	1	000.02	000.00

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Malaraeus n. sp.	17	000.29	000.05
Totals for this type of ectoparasite	5906	100.00	016.17
Ixodoidea			
Amblyomma sp.	6	000.03	000.02
Anomalohimalaya lama	102	000.48	000.28
Argas hermanni	3	000.01	000.01
Argas himalayensis	2	000.01	000.01
Argas vespertilionis group	40	000.19	000.11
Argas sp. #2	2	000.01	000.01
Argas sp.	2	000.01	000.01
Boophilus microplus	4875	023.15	013.35
Dermacentor auratus	128	000.61	000.35
Dermacentor atrosignatus	2	000.01	000.01
Dermacentor everestianus	538	002.55	001.47
Dermacentor sp.	36	000.17	000.10
Haemaphysalis aborensis	2	000.01	000.01
Haemaphysalis anomala	7	000.03	000.02
Haemaphysalis aponommoides	2373	011.27	006.50
Haemaphysalis birmaniae	1350	006.41	003.70
Haemaphysalis bispinosa	3587	017.03	009.82
Haemaphysalis canestrinii	4	000.02	000.01
Haemaphysalis cornupunctata	94	000.45	000.26
Haemaphysalis doenitzi	15	000.07	000.04
Haemaphysalis garhwalensis	3	000.01	000.01
Haemaphysalis himalaya	711	003.38	001.95
Haemaphysalis howletti	56	000.27	000.15
Haemaphysalis indica	138	000.66	000.38
Haemaphysalis minuta	80	000.38	000.22
Haemaphysalis montgomeryi	193	000.92	000.53
Haemaphysalis nepalensis	1879	008.92	005.14
Haemaphysalis ornithophila	2	000.01	000.01
Haemaphysalis ramachandrai	25	000.12	000.07
Haemaphysalis spinigera	21	000.10	000.06
Haemaphysalis warburtoni	463	002.20	001.27
Haemaphysalis wellingtoni	140	000.66	000.38
Haemaphysalis sp.	420	001.99	001.15
Haemaphysalis darjeeling	1	000.00	000.00

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Hyalomma anatolicum anatolicum	3	000.01	000.01
Hyalomma brevipunctata	19	000.09	000.05
Hyalomma detritum	1	000.00	000.00
Hyalomma marginatum isaaci	12	000.05	000.03
Hyalomma marginatum turanicum	66	000.31	000.18
Hyalomma sp.	188	000.80	000.51
Ixodes acutitarsus	408	001.94	001.12
Ixodes himalayensis	41	000.19	000.11
Ixodes hyatti	85	000.40	000.23
Ixodes mitchelli	47	000.22	000.13
Ixodes nuttallianus	87	000.41	000.24
Ixodes lindbergi (="ovatus")	1183	005.62	003.24
Ixodes redikorzevi group	100	000.47	000.27
Ixodes shahi	16	000.08	000.04
Ixodes tanuki	27	000.13	000.07
Ixodes sp. 1	193	000.92	000.53
Ixodes sp. 2	76	000.36	000.21
Ixodes sp. A	27	000.13	000.07
Ixodes sp. B	52	000.25	000.02
Ixodes sp. B facies	7	000.03	000.02
Ixodes kuntzi	1	000.00	000.00
Ixodes berlesei	4	000.02	000.01
Ornithodoros coniceps	11	000.05	000.03
Ornithodoros (Reticulinasus) piriformis	205	000.97	000.56
Rhipicephalus haemaphysaloides	841	003.99	002.30
Rhipicephalus ramachandrai	1	000.00	000.00
Rhipicephalus sanguineus	1	000.00	000.00
Rhipicephalus turanicus	56	000.27	000.15
Rhipicephalus sp.	2	000.01	000.01
Totals for this type of ectoparasite	21061	100.00	057.66
Diptera			
Hippobosca longipennis	51	017.23	000.14
Icosta maquilingensis	3	001.01	000.01
Lipoptena axis	62	020.95	000.17
Lipoptena pauciseta	2	000.68	000.01
Lipoptena timida	1	000.34	000.00
Lipoptena weidneri	18	006.08	000.05

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Melophagus ovinus	38	012.84	000.10
Ornithoica bistativa	1	000.34	000.00
Ornithomya avicularia	5	001.69	000.01
Ornithophila metallica	1	000.34	000.00
Phthona leptoptera	4	001.35	000.01
Pseudolynchia canariensis	6	002.03	000.02
Nycteribiids (Nycteribiidae)	52	017.57	000.14
Cyclopodia sykesii	51	017.23	000.14
Streblids (Streblidae)	1	000.34	000.00
Totals for this type of ectoparasite	296	100.00	000.81
Mites			
Androlaelaps sp.	2	000.05	000.01
Androlaelaps fahrenholzi	30	000.81	000.08
Androlaelaps hermaphrodita	3	000.08	000.01
Androlaelaps macroventralis	5	000.13	000.01
Androlaelaps marshalli	2	000.05	000.01
Androlaelaps pavlovskii	19	000.51	000.05
Androlaelaps soricinus	85	002.29	000.23
Androlaelaps triangularis	5	000.13	000.01
Cheyletus sp.	2	000.05	000.01
Dermanyssus sp.	1	000.03	000.00
Eucheyletia sinensis	2	000.05	000.01
Eulaelaps stabularis	38	001.03	000.10
Gahrliepia (Schoengastiella) sp.	16	000.43	000.04
Haemogamasus sp.	8	000.22	000.02
Haemogamasus citelli	2	000.05	000.01
Haemogamasus dorsalis	7	000.19	000.02
Haemogamasus horridus	2	000.05	000.01
Haemogamasus japonicus	2	000.05	000.01
Haemogamasus nidiformis	97	002.62	000.27
Haemogamasus oliviformis	23	000.62	000.06
Haemogamasus suncus	231	006.23	000.63
Haemolaelaps sp.	5	000.13	000.01
Haemolaelaps fenilis	2	000.05	000.01
Haemolaelaps traubi	2	000.05	000.01
Haemolaelaps triangularis	33	000.89	000.09
Haemolaelaps fahrenholzi	2	000.05	000.01
Histionyssus sp.	25	000.70	000.07
Histionyssus latiscutatus	64	001.73	000.18
Histionyssus suncus	2	000.05	000.01
Hypoaspis sp.	7	000.19	000.02
Hypoaspis lubrica	16	000.43	000.04

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Hypoaspis miles	1	000.03	000.00
Hypoaspis sardoa	10	000.27	000.03
Laelaps sp.	70	001.89	000.19
Laelaps algericus	1902	051.34	005.21
Laelaps agilis	21	000.57	000.06
Laelaps buxtoni	3	000.08	000.01
Laelaps echidnina	119	003.21	000.33
Laelaps myonyssognathus	34	000.92	000.09
Laelaps nuttalli	149	004.02	000.41
Laelaps traubi	106	002.86	000.29
Laelaps turkestanica	350	009.45	000.96
Liponyssoides muris	3	000.08	000.01
Myonyssus montanus	51	001.38	000.14
Myonyssus tuberosus	13	000.35	000.04
Ornithonyssus bacoti	3	000.08	000.01
Ornithonyssus bursa	3	000.08	000.01
Ornithonyssus sylviarum	3	000.08	000.01
Pellonyssus viator	10	000.27	000.03
Proctophyllodes sp.	4	000.11	000.01
Proterothrix sp.	4	000.11	000.01
Rhyzolaelaps inaequipites	9	000.24	000.02
Spinturnex sp.	5	000.13	000.01
Spinturnex plecotinus	2	000.05	000.01
Falculifer rostratus	7	000.19	000.02
Pterolichus obtusus	21	000.57	000.06
Sokoloviana sp.	4	000.11	000.01
Macrochelidae	5	000.13	000.01
Ascidae	9	000.24	000.02
Pachylaelapidae	3	000.08	000.01
Parasitidae	2	000.05	000.01
Pyemotidae	2	000.05	000.01
Amerosiidae	1	000.03	000.00
Neolaelaps spinosus	31	000.84	000.08
Phytoseiidae	1	000.03	000.00
Macrocheles sp.	2	000.05	000.01
Listrophoridae	1	000.03	000.00
Totals for this type of ectoparasite	3705	100.00	010.14
Mallophaga			
Actornithophilus hoplopteri	40	001.18	000.11
Amyrsidea minuta	58	001.71	000.16
Amyrsidea phaeostoma	2	000.06	000.01
Amyrsidea sp.	123	003.62	000.34
Anaticola crassicornis	6	000.18	000.02

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Bovicola hemitragi	18	000.53	000.05
Bovicola limbata	186	005.47	000.51
Bovicola ovis	13	000.38	000.04
Bovicola caprae	10	000.29	000.03
Bovicola dimorpha	7	000.21	000.02
Bovicola bovis	6	000.18	000.02
Bovicola sp.	3	000.09	000.01
Bruelia daumae	19	000.55	000.05
Bruelia mahrastan	22	000.65	000.06
Bruelia meinertzhageni	2	000.06	000.01
Bruelia saliemi mollii	12	000.35	000.03
Bruelia saliemi saliemi	4	000.12	000.01
Bruelia sehri	12	000.35	000.03
Bruelia sp.	48	001.41	000.13
Bruelia biguttata	21	000.62	000.06
Chelopistes lervicola	72	002.12	000.20
Colinicola meinertzhageni	27	000.79	000.07
Colocerus sp.	53	001.56	000.15
Colpocephalum fregili	4	000.12	000.01
Colpocephalum tausi	102	003.00	000.28
Colpocephalum turbinatum	36	001.05	000.10
Columbicola columbae bacillus	30	000.88	000.08
Columbicola guimaraesi	5	000.15	000.01
Columbicola orientalis	33	000.97	000.09
Columbicola tschulyschman	59	001.74	000.16
Craspedorrhynchus nisi	11	000.32	000.03
Craspedorrhynchus spathulatus	7	000.21	000.02
Cuculogaster theresae	22	000.65	000.06
Cuculogaster obscurior	1	000.03	000.00
Cuculiphilus snodgrassi	17	000.50	000.05
Degeeriella regalis	23	000.68	000.06
Falcolius jordani	2	000.06	000.01
Felicola rohani	102	003.00	000.28
Goniocotes creber	1	000.03	000.00
Goniocotes haplogonus	189	005.56	000.52
Goniocotes rectangulatus	8	000.24	000.02
Goniocotes sp.	49	001.44	000.13
Goniocotes diplogonus	15	000.44	000.04
Goniocotes alatus	1	000.03	000.00
Gonoides dentatus	6	000.18	000.02
Gonoides dispar	5	000.15	000.01
Gonoides dissimilis	24	000.71	000.07
Gonoides eurygaster	130	003.83	000.36
Gonoides ithaginis	49	001.44	000.13
Gonoides megaceros	8	000.24	000.02

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Gonoides meinertzhageni	6	000.18	000.02
Gonoides pavonis	74	002.18	000.20
Gonoides sp.	2	000.06	000.01
Gonoides spinicornis	5	000.15	000.01
Heterodoxus spiniger	103	003.03	000.28
Kurodaia deignani	8	000.24	000.02
Laemobothrion maximum	4	000.12	000.01
Lagopoecus heterotypus	43	001.27	000.12
Lagopoecus sp.	33	000.97	000.09
Lagopoecus meinertzhageni	3	000.09	000.01
Lipeurus caponis	57	001.68	000.16
Lipeurus pavo	29	000.85	000.08
Lipeurus sp.	12	000.35	000.03
Lipeurus introductus	5	000.15	000.01
Menacanthus kalatitar	37	001.09	000.10
Menacanthus sp.	114	003.35	000.31
Menacanthus stramineus	5	000.15	000.01
Menopon gallinae	280	008.24	000.77
Menopon interpositum	1	000.03	000.00
Meropoecus caprai	1	000.03	000.00
Myrsidea satbhai	43	001.27	000.12
Myrsidea sp.	26	000.77	000.07
Myrsidea anaspila	2	000.06	000.01
Myrsidea insolita	10	000.20	000.03
Oxylipeurus baileyi ithaginis	147	004.33	000.40
Oxylipeurus himalayensis burmeisteri	292	008.59	000.80
Penenirmus zeylanicus	12	000.35	000.03
Penenirmus sp.	1	000.03	000.00
Philopterus extraneus	16	000.47	000.04
Philopterus sp.	57	001.68	000.16
Quadraceps bicuspis	21	000.62	000.06
Quadraceps dasi	10	000.29	000.03
Quadraceps hoplopteri	96	002.83	000.26
Quadraceps insignis	3	000.09	000.01
Quadraceps sp.	2	000.06	000.01
Saemundssonia africana	6	000.18	000.02
Strachiella mustelae	16	000.47	000.04
Strigiphilus bramae	17	000.50	000.05
Strigiphilus ketupae	27	000.79	000.07
Trichodectes canis	35	001.03	000.10
Turniccla angustissimus	8	000.24	000.02
Alcedoecus annularis	6	000.18	000.02
Meromenopon sp.	1	000.03	000.00
Alcedoffula alcedinis	6	000.18	000.02
Cuculicola sp.	4	000.12	000.01

Ectoparasite	Number Collected	% of this Ectoparasite	% of all Ectoparasites
Mulcticola sp.	7	000.21	000.02
Echinophilopterus sp.	2	000.06	000.01
Totals for this type of ectoparasite	3398	100.00	009.30
Anoplura			
Ancistroplax crocidurae	10	000.46	000.03
Ancistroplax sp.	3	000.14	000.01
Enderleinellus nishimauri	17	000.79	000.05
Haematopinus eurysternus	3	000.14	000.01
Haematopinus suis	124	005.74	000.34
Haematopinus tuberculatus	121	005.60	000.33
Haemodipsus lyriocephalus	109	005.04	000.30
Haemodipsus ventricosus	12	000.56	000.03
Hoplopleura acanthopus	213	009.86	000.58
Hoplopleura capitosa	381	017.63	001.04
Hoplopleura maniculata	148	006.85	000.41
Hoplopleura ochotonae	24	001.11	000.07
Hoplopleura oenomydis	12	000.56	000.03
Hoplopleura pacifica	99	004.58	000.27
Hoplopleura sicata	33	001.53	000.09
Hoplopleura dissicula	19	000.88	000.05
Hoplopleura affinis	5	000.23	000.01
Hoplopleura erismata	11	000.51	000.03
Hoplopleura sp.	12	000.56	000.03
Linognathus africanus	80	003.70	000.22
Linognathus setosus	3	000.14	000.01
Linognathus vituli	79	003.66	000.22
Linognathus sp.	1	000.05	000.00
Neohaematopinus echinatus	23	001.06	000.06
Neohaematopinus elbeli	6	000.28	000.02
Neohaematopinus petauristae	24	001.11	000.07
Neohaematopinus sp.	3	000.14	000.01
Pediculus humanus	64	002.96	000.18
Polyplax asiatica	100	004.63	000.27
Polyplax pricei	1	000.05	000.00
Polyplax reclinata	271	012.54	000.74
Polyplax sp.	46	002.13	000.13
Polyplax spinulosa	8	000.37	000.02
Polyplax stephensi	1	000.05	000.00
Polyplax serrata	1	000.05	000.00
Solenopotes capillatus	2	000.09	000.01
Solenopotes muntiacus	62	002.87	000.17
Haematomyzus elephantis	30	001.39	000.08
Totals for this type of ectoparasite	2161	100.00	005.92

APPENDIX IV.

MAMMALS COLLECTED FROM EACH LIFE ZONE

Terai (West)

Mammal	Number Collected	% in Terai (West) Life Zone	% in all Life Zones
Antilope cervicapra	2	001.56	000.05
Axis axis	6	004.69	000.16
A. porcinus	3	002.34	000.08
Bandicota bengalensis	2	001.56	000.05
Boselaphus tragocamelus	3	002.34	000.08
Canis aureus	7	005.47	000.18
Cervus unicolor	2	001.56	000.05
Crocidura sp.	1	000.78	000.02
Felis chaus	7	005.47	000.18
F. viverrina	1	000.78	000.02
Funambulus pennanti	7	005.47	000.18
Golunda ellioti myothrix	2	001.56	000.05
Herpestes edwardsi	2	001.56	000.05
Lepus nigricollis ruficaudatus	5	003.91	000.13
Millardia meltada pallidor	9	007.03	000.24
Mus booduga	27	021.09	000.75
Panthera pardus	1	000.78	000.02
P. tigris	2	001.56	000.05
Paradoxurus hermaphroditus	1	000.78	000.02
Petaurista petaurista	2	001.56	000.05
Rattus rattus brunneusculus	22	017.19	000.60
Suncus murinus	4	003.13	000.10
S. stoliczkanus	2	001.56	000.05
Sus scrofa cristatus	2	001.56	000.05
Tatera indica	1	000.78	000.02
Vandeleuria oleracea dumeticola	4	003.13	000.10
Vulpes bengalensis	1	000.78	000.02
Totals for this Life Zone	128	100.00	3.35

Terai (East)

		% in Terai (East) Life Zone	
Axis axis	3	006.67	000.08
Boselaphus tragocamelus	1	002.22	000.02
Canis aureus	1	002.22	000.02
Cannomys badius	2	004.44	000.05

Mammal	Number Collected	% in Terai (East) Life Zone	% in all Life Zones
Cervus unicolor	1	002.22	000.02
Felis chaus	4	008.89	000.10
Funambulus pennanti	5	011.11	000.13
Herpestes edwardsi	1	002.22	000.02
Lepus nigricollis ruficaudatus	1	002.22	000.02
Macaca mulatta	2	004.44	000.05
Mus booduga	7	015.57	000.18
M. cervicolor	1	002.22	000.02
Panthera pardus	1	002.22	000.02
P. tigris	3	006.67	000.08
Rattus rattus brunneusculus	8	017.79	000.21
Suncus murinus	1	002.22	000.02
Sus scrofa cristatus	2	004.44	000.05
Vulpes bengalensis	1	002.22	000.02
Totals for this Life Zone	45	100.00	1.11

Siwaliks		% in Siwaliks Life Zone	
Bandicota bengalensis	1	002.50	000.02
Callosciurus pygerythrus	12	030.00	000.32
Canis aureus	3	007.50	000.08
Cannomys badius	2	005.00	000.05
Cervus unicolor	1	002.50	000.02
Felis bengalensis	1	002.50	000.02
F. chaus	1	002.50	000.02
Funambulus pennanti	1	002.50	000.02
Herpestes auropunctatus	5	012.50	000.13
H. edwardsi	5	012.50	000.13
Lepus nigricollis ruficaudatus	2	005.00	000.05
Muntiacus muntjak	1	002.50	000.02
Mus booduga	2	005.00	000.05
Suncus murinus	1	002.50	000.02
Sus scrofa cristatus	1	002.50	000.02
Viverra zibetha	1	002.50	000.02
Totals for this Life Zone	40	100.00	0.99

Mahabharat Lekh		% in Mahabharat Lekh Life Zone	
Callosciurus pygerythrus	5	003.01	000.13
Canis aureus	3	001.80	000.08

Mammal	Number Collected	% in Mahabharat Lekh Life Zone	% in all Life Zones
Felis bengalensis	2	001.20	000.05
F. chaus	2	001.20	000.05
Herpestes auropunctatus	10	006.02	000.27
H. edwardsi	1	000.60	000.02
Lepus nigricollis ruficaudatus	5	003.01	000.13
Macaca mulatta	1	000.60	000.02
Manis pentadactyla	1	000.60	000.02
Martes flavigula	2	001.20	000.05
Muntiacus muntjak	2	001.20	000.05
Mus musculus ssp.	1	000.60	000.02
M. m. homourus	12	007.25	000.32
M. m. urbanus	37	022.30	001.00
Petaurista magnificus	1	000.60	000.02
Rattus nitidus	2	001.20	000.05
R. rattus brunneus	47	028.31	001.30
R. r. brunneusculus	25	015.10	000.70
Viverra zibetha	1	000.60	000.02
Vulpes bengalensis	3	001.80	000.08
Totals for this Life Zone	166	100.00	4.46

Duns		% in Duns Life Zone	
Axis axis	3	005.35	000.08
Bandicota bengalensis	1	001.79	000.02
Canis aureus	1	001.79	000.02
Cervus unicolor	1	001.79	000.02
Crocidura sp.	2	003.57	000.05
Felis chaus	1	001.79	000.02
F. viverrina	1	001.79	000.02
Funambulus pennanti	3	005.35	000.08
Herpestes edwardsi	1	001.79	000.02
Lepus nigricollis ruficaudatus	3	005.35	000.08
Millardia meltada pallidor	3	005.35	000.08
Mus booduga	2	003.57	000.05
M. cervicolor	2	003.57	000.05
M. platythrix gurkha	5	008.93	000.13
Nesokia indica	3	005.35	000.08
Panthera tigris	1	001.79	000.02
Rattus rattus brunneusculus	5	008.93	000.13
Suncus murinus	12	021.43	000.32
Sus scrofa cristatus	1	001.79	000.02
Tatera indica	2	003.57	000.05

Mammals	Number Collected	% in Duns Life Zone	% in all Life Zones
Vandeleuria oleracea dumeticola	1	001.79	000.02
Vulpes bengalensis	2	003.57	000.05
Totals for this Life Zone	56	100.00	1.41

Midlands (West)	Number Collected	% in Midlands (West) Life Zone	% in all Life Zones
Ailurus fulgens	1	000.21	000.02
Apodemus flavicollis	101	021.17	002.75
A. sylvaticus	29	006.08	000.80
Canis aureus	2	000.42	000.05
Crocidura horsfieldi	13	002.72	000.35
Martes flavigula	1	000.21	000.02
Mus musculus homourus	114	023.90	003.10
M. m. urbanus	10	002.10	000.27
Mustela sibirica	2	000.42	000.05
Ochotona roylei	1	000.21	000.02
Petaurista magnificus	1	000.21	000.02
Pitymys sikimensis	117	024.54	003.21
Rattus turkestanicus	45	009.43	001.21
Sorex minutus	3	000.63	000.08
Soriculus caudatus	13	002.73	000.35
S. nigrescens	21	004.40	000.60
Suncus murinus			
Totals for this Life Zone	477	100.00	12.98

Midlands (Central)		% in Midlands (Central) Life Zone	
Ailurus fulgens	1	000.08	000.02
Capricornis sumatraensis	3	000.24	000.08
Crocidura attenuata	1	000.08	000.02
Cuon alpinus	1	000.08	000.02
Dremomys lokriah	18	001.49	000.50
Golunda ellioti myothrix	2	000.16	000.05
Hemitragus jemlahicus	1	000.08	000.02
Hylopetes alboniger	4	000.33	000.10
Lepus nigricollis ruficaudatus	1	000.08	000.02
Martes flavigula	1	000.08	000.02
Muntiacus muntjak	4	000.33	000.10

Midlands (Central) Mammals	Number Collected	% in Midlands (Central) Life Zone	% in all Life Zones
Mus musculus ssp.	35	002.89	000.95
M. m. homourus	196	016.19	005.40
M. m. urbanus	348	028.75	009.52
Mustela sibirica	5	000.41	000.13
Nemorhaedus goral	4	000.33	000.16
Ochotona roylei	93	007.69	002.56
Petaurista elegans caniceps	3	000.24	000.08
P. magnificus	13	001.07	000.35
Pitymys sikimensis	78	006.45	002.15
Presbytis entellus	2	000.16	000.05
Rattus sp.	1	000.08	000.02
R. eha	10	000.83	000.27
R. fulvescens	53	004.39	001.45
R. nitidus	9	000.74	000.24
R. niviventer	31	002.56	000.84
R. rattus ssp.	4	000.33	000.10
R. r. brunneusculus	11	000.91	000.29
R. turkestanicus	33	002.73	000.89
Sorex cylindricauda	35	002.89	000.95
Soriculus caudatus	87	007.18	002.40
S. leucops	2	000.16	000.05
S. nigrescens	85	007.02	002.35
Suncus etruscus pygmaeoides	10	000.83	000.27
S. murinus	16	001.32	000.43
Vandeleuria oleracea dumeticola	2	000.16	000.05
V. o. modesta	8	000.66	000.21
Totals for this Life Zone	1211	100.00	33.11

Midlands (East)		% in Midlands (East) Life Zone	
Ailurus fulgens	1	000.15	000.02
Belomys pearsoni	2	000.30	000.05
Callosciurus pygerythrus	2	000.30	000.05
Canis aureus	2	000.30	000.05
Capricornis sumatraensis	3	000.45	000.08
Crocidura attenuata	2	000.30	000.05
Dremomys lokriah	10	001.50	000.27
Felis chaus	1	000.15	000.02
Manis pentadactyla	1	000.15	000.02
Martes flavigula	2	000.30	000.05
Muntiacus muntjak	5	000.75	000.13

Midlands (East) Mammals	Number Collected	% in Midlands (East) Life Zone	% in all Life Zones
Mus booduga	4	000.60	000.10
M. cervicolor	1	000.15	000.02
M. musculus ssp.	5	000.75	000.13
M. m. homourus	116	017.42	003.16
M. m. urbanus	35	005.26	000.94
Nectogale elegans	3	000.45	000.08
Nemorhaedus goral	2	000.30	000.05
Ochotona roylei	4	000.60	000.10
Paguma larvata	4	000.60	000.10
Petaurista elegans caniceps	7	001.05	000.18
P. magnificus	5	000.75	000.13
Pitymys sikimensis	101	015.17	002.75
Rattus eha	57	008.56	001.54
R. fulvescens	44	006.61	001.19
R. niviventer	1	000.15	000.02
R. rattus ssp.	42	006.31	001.14
R. turkestanicus	7	001.05	000.18
Ratufa bicolor	2	000.30	000.05
Sorex cylindricauda	8	001.20	000.21
Soriculus caudatus	94	014.11	002.56
S. leucops	3	000.45	000.08
S. nigrescens	76	011.41	002.06
Suncus murinus	10	001.50	000.27
Sus scrofa cristatus	1	000.15	000.02
Viverra zibetha	3	000.45	000.08
Totals for this Life Zone	666	100.00	17.93

Inner Himalayas		% in Inner Himalayas Life Zone	
Alticola stracheyi	5	000.78	000.13
Hemitragus jemlahicus	3	000.47	000.08
Martes flavigula	2	000.31	000.05
Mus musculus homourus	93	014.59	002.55
M. m. urbanus	110	017.25	002.98
Mustela sibirica	5	000.78	000.13
Ochotona roylei	45	007.06	001.22
Pitymys sikimensis	60	009.40	001.62
Pseudois nayaur	1	000.15	000.02
Rattus eha	75	011.77	002.05
R. nitidus	5	000.78	000.13
R. turkestanicus	5	000.78	000.13
Sorex cylindricauda	30	004.70	000.81

Inner Himalayas Mammals	Number Collected	% in Inner Himalayas Life Zone	% in all Life Zones
Soriculus caudatus	134	021.00	003.68
S. nigrescens	63	009.87	001.74
Totals for this Life Zone	638	100.00	17.32
Tibetan Plateau		% in Tibetan Plateau Life Zone	
Alticola stoliczkanus	2	008.58	000.62
Apodemus sylvaticus	170	063.43	004.70
Lepus oiostolus	3	001.12	000.08
Mus musculus ssp.	30	011.20	000.83
Mustela altaica	1	000.37	000.02
Ochotona daurica	5	001.87	000.13
O. macrotis	1	000.37	000.02
O. sp.	4	001.49	000.10
Pitymys leucurus	21	007.84	000.59
Presbytis entellus	1	000.37	000.02
Rattus rattus ssp.	5	001.87	000.13
Sorex minutus	3	001.12	000.08
Vulpes ferrilata	1	000.87	000.02
Totals for this Life Zone	268	100.00	7.34
OVERALL TOTALS FOR ALL LIFE ZONES	3695		100.00